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Effectiveness of a Caremap for Treatment of Elderly Patients with Hip Fracture

by

Lauren Alison Beaupre ©

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requirements for the degree of *Doctor of Philosophy*

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ABSTRACT

Objectives: The primary objectives of this project were to determine how the use of a caremap for treatment of elderly hip fracture patients affected functional recovery, institutionalization and health-related quality of life in the first six-months following hip fracture. Secondary objectives were to examine differences in morbidity, in-hospital mortality and health service utilization before and after caremap implementation. Finally, tertiary objectives were to determine if care delivery differed before and after the caremap was introduced.

Methods: Two population-based inception cohorts of hip fracture patients 65 years and older, the first group (n=468) enrolled between July 1996 and September 1997 prior to caremap implementation and the second group (n=451) enrolled between July 1999 and September 2000 following implementation of standardized care, were used to meet study objectives. Subjects completed standardized questionnaires examining function and health-related quality of life while in hospital and then at follow-up telephone interviews three and six-months postoperatively. Institutionalization rates were obtained during follow-up interviews by determining patients' residence at time of interview. To meet the secondary and tertiary study objectives, chart reviews were completed on all eligible subjects who sustained a hip fracture during the study time periods to determine complications, mortality and service delivery outcomes.

Results: Functional recovery was improved at three months postoperatively in subjects with poor social contact in the post caremap cohort after adjusting for confounders. Risk-adjusted institutionalization was also reduced in this same patient group. Health-related quality of life was not different between cohorts. Morbidity as measured by postoperative complications and intensive care unit admissions was significantly reduced in the Caremap cohort, but there was no difference in risk-adjusted in-hospital mortality between groups. Care delivery was improved in the Caremap cohort with less variation in practice in terms of timing of interventions and medication profiles.

Conclusion: Overall, using a caremap during the perioperative period did not affect function, health-related quality of life or institutionalization in elderly hip fracture patients. However, function was improved and institutionalization reduced in patients with poor social contacts in the Caremap cohort. Morbidity was also reduced in the Caremap compared to the Control cohort.

DEDICATION

To my family who gave me unending support and encouragement throughout this journey.

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LIST OF SYMBOLS, NOMENCLATURE OR ABBREVIATIONS

SYMBOLS

Regression Co-Efficient	β
Chi-Square	χ^2

ABBREVIATIONS

Activities of Daily Living	ADL
Analysis of Covariance	ANCOVA
Analysis of Variance	ANOVA
Avascular Necrosis	AVN
Basic Activities of Daily Living	BADL
Barthel Functional Index	BFI
Body Mass Index	BMI
Bone Mineral Density	BMD
Capital Health	CH
Cochrane Systematic Review	CSR
DeepVein Thromboses	DVT
End Stage Renal Disease	ESRD
Epidémiologie l'Ostéoporose	EPIDOS
Established Populations for Epidemiological Studies	EPESE
Femoral Neck	FN
Functional Independence Measure	FIM
Gastro-Intestinal	GI
Hazard Ratio	HR
Health Related Quality of Life	HRQoL
Hemi-Arthroplasty	HA
Instrumental Activities of Daily Living	IADL
Internal Fixation	IF
Intertrochanteric	IT
Item Response Theory	IRT
Intensive Care Unit	ICU
Intramedullary	IM
Length of Stay	LOS
Longitudinal Study on Aging	LSOA
Long-term Care	LTC

Mediterranean Osteoporosis Study	**MEDOS**
Mental Health Composite	**MHC**
Mini-Mental Status Examination	**MMSE**
National Health and Nutrition Examination Survey	**NHANES**
Occupational Therapy	**OT**
Odds Ratio	**OR**
Older American Resources and Services	**OARS**
Ordinary Least Squares	**OLS**
Physical Health Composite	**PHC**
Physical Therapy	**PT**
RAND-12 Health Status Inventory	**RAND-12 HSI**
Randomized Clinical Trial	**RCT**
Relative Odds	**RO**
Relative Risk	**RR**
Royal Alexandra Hospital	**RAH**
Short Form-12	**SF-12**
Standard Deviation	**SD**
Standard Error	**SE**
Statistical Package for the Social Sciences	**SPSS**
Study of Osteoporotic Fractures	**SOF**
Sub-trochanteric	**ST**
Total Hip Arthroplasty	**THA**
Total Lymphocyte Count	**TLC**
United States of America	**USA**
University of Alberta Hospital	**UAH**
Urinary Tract Infections	**UTI**

1. INTRODUCTION

1.1. Overview of the "Hip Fracture Problem"

Hip fractures in the elderly are a common occurrence. These fractures can have devastating effects on the patient's quality of life with 50% of patients not returning to their pre fracture level of function. [1-4] Subjects living in the community prior to their fracture are at significantly increased risk of requiring an increased level of care post fracture that may necessitate moving into an institutional setting.[5-7] In addition, elderly persons who have a hip fracture are at increased risk of mortality for at least one year following fracture compared to elderly persons in similar health who do not sustain a hip fracture.[8] In a time trade-off study undertaken with elderly women who had not experienced a hip fracture, perceptions of outcomes following hip fracture were examined. Researchers reported a significant proportion of subjects viewed a hip fracture as worse than death.[9]

The incidence of hip fracture is expected to rise exponentially over the next few decades as the population ages.[10,11] In 1990, it was estimated that 1.3 - 1.7 million hip fractures occurred globally. [12,13] With increasing life expectancy and the exponential rise in hip fracture incidence with increasing age, the number of hip fractures occurring globally is projected to rise to 4.5 - 6.3 million annually in 2050.[12,13]

Capital Health (CH) is a large health region in the province of Alberta that serves the population of metropolitan Edmonton as well as acting as the tertiary referral centre for the northern part of the province. On an annual basis, CH admits approximately 700-750 patients for treatment of hip fracture. Although these patients represent 14% of the overall orthopaedic caseload, they utilize 22% of the orthopaedic bed-days, a finding reported by other orthopaedic services.[14]

As a growing population, these patients will place an increased demand on a healthcare system that is already struggling to manage current patient loads. Determining methods of delivering health care that promote optimal functional recovery within the fiscal constraints of the healthcare system will present an immense challenge to healthcare providers over the next few decades. This patient population is also medically fragile and will require multidisciplinary care across several settings, including acute, sub-acute and rehabilitation as well as long-term care (LTC) and homecare. Developing evidence-based models of care that use health resources effectively and efficiently without compromising patient outcomes has relevance to both clinicians and policymakers.

1.2. Caremaps in the Hip Fracture Population

As early as 1988, standardized medical care in the form of "caremaps" or clinical pathways has been suggested as a means to improve the effectiveness and efficiency of care offered to these patients.[15] Previous studies have indicated that multi-disciplinary care in the acute and sub-acute settings has inconsistent effects on morbidity, mortality, functional recovery and health service utilization.[16-19] Most of these studies have utilized small select subsets of this patient population, excluding those patients who were admitted from long-term care or who have cognitive impairment.

Additionally, comparison of outcomes across the different studies is difficult due to the variation in outcomes and outcome measures chosen by each study.

In fact, a recent systematic review undertaken by the Cochrane Library Musculoskeletal Group concluded that mortality was unaffected by standardized multidisciplinary rehabilitation, but the effect of such interventions on morbidity, function and health service utilization was unclear.[20]

Further increasing the difficulty of comparing outcomes among studies is that the intervention itself is often not well described. Whether standardized care is deemed more effective than "usual care" will depend, in part, on how "usual care" is delivered. In most cases, "usual care" is already multi-disciplinary, and the effect of standardizing care may not alter outcomes significantly. To differentiate service delivery between comparison groups requires measurement of processes expected to change through standardization of care. The effect on outcomes can only be evaluated after confirmation of changes in service delivery.

In 1994, the two hospitals that treated hip fractures within the CH, Royal Alexandra Hospital (RAH) and University of Alberta Hospital (UAH), began development of patient caremaps for high frequency diagnoses that had a prolonged length of hospital stay. The aim of the hip fracture caremap was to standardize the care and the treatment time line for specific interventions. Prior to the caremap intervention, there was an inconsistent approach to treatment of patients with hip fracture. The caremap was developed through review of available literature and clinical consensus by a multidisciplinary team that included surgical, nursing, geriatric, rehabilitation, pharmacy and dietary services. It involved staff from the surgical hospitals only and included care up to discharge from the initial hospitalization. Because clinical specialists were involved in the development of the caremap, the caremap was widely accepted by clinicians when it was initiated in March 1998. All patients admitted to the RAH and UAH with hip fractures have the caremap orders and treatment plan placed on their chart in the Emergency department.

The specific goals of the caremap were to: 1) standardize care within the health region, 2) regulate narcotic use, 3) decrease complications, and 4) provide discharge guidelines in regards to place of discharge. It was anticipated that if these goals could be met, health service utilization could be improved through a reduced hospital length of stay (LOS).

1.3. Purpose of the Study

The purpose of this project was to determine how implementation of a caremap for the CH hip fracture population affected the first six months following fracture in terms of :

Functional recovery. This objective was measured using data obtained through patient interviews with standardized outcome measures.

Health-Related Quality of Life (HRQoL). This objective was measured using data obtained through patient interviews using a standardized outcome measure.

Institutionalization rate. This information was measured using data obtained through patient interviews and from regional databases.

Morbidity and Mortality in hospital. These objectives were measured through data obtained from chart reviews.

Length of Stay and Re-admissions. These objectives were measured by examining data regarding LOS in the acute setting, and re-admissions over the six-month follow-up period. Data were obtained from review of medical records and regional databases.

Delivery of Patient Care in hospital. This objective was measured by examining data regarding medication profiles, and timing of surgical, medical and rehabilitation protocols.

Two independent population-based inception cohorts were utilized in a pre/post design to evaluate how processes and outcomes in the initial six-month postoperative recovery period differed as a result of acute care being delivered in a standardized format. Both cohorts included patients from LTC settings as well as patients with cognitive impairment, making the results of our study generalizable to the entire elderly hip fracture population. This is in contrast to the majority of studies that have limited their groups to the "best" subset of hip fracture patients, those who are admitted from the community with no history of cognitive impairment.

My study examined not only in-hospital recovery, but also followed patients through the initial six-month postoperative period to detail functional recovery, HRQoL and health service utilization over this extended time period.

2. CRITICAL APPRAISAL OF THE LITERATURE

A detailed search strategy was utilized to identify appropriate studies for review (See Appendix 9.1).

2.1. Anatomy of a Hip Fracture

Hip fractures can be classified into two broad categories: intracapsular and extracapsular fractures. Specifically, the intracapsular fractures encompass those fractures that occur at the femoral neck (FN) while the extracapsular fractures encompass both intertrochanteric (IT) and subtrochanteric (ST) fractures. Each of these fracture types require different surgical management with resultant differences in complications and prognosis.

Different characteristics lead patients to sustain either a FN or a trochanteric type fracture. Females who have IT fractures are more likely to be older, require an assistive device for walking and assistance in Activities of Daily Living (ADL) than females with FN fractures.[21-23] In addition, IT fractures occur in patients who are thinner, shorter, have lower bone mass at the proximal femur and spine, and a greater prevalence of previous fragility fractures than those with fractures of the FN.[24,25]

However, at all ages except for females older than 90 years, FN fractures are slightly more common than IT fractures (ratio = 1.2:1).[26,27] This ratio decreases to 1.1:1 in females greater than 80 years and achieves unity at 90 years. The ratio of FN to IT fractures is unchanged in all age groups in males. The hypothesis for reported gender differences is that osteoporosis occurs more commonly in women and primarily affects trabecular bone. The FN is made of 50% cortical and 50% trabecular bone while the IT area is made up of 75% trabecular bone. Thus, decreasing bone mass with increasing age will affect the IT area greater than the femoral neck region.[24] More patients may experience the poorer outcomes associated with IT fracture in ensuing years as the overall population is aging, a process linked with increasing incidence of hip fracture.

Antero-posterior and lateral radiographs are used to confirm a hip fracture and assess fracture location and severity. In up to 8% of patients, plain films will be normal or indeterminate and Magnetic Resonance Imaging (MRI) scan will be required to confirm whether or not a patient has a fracture. Regardless of the location of fracture, the patient will receive some form of surgical fixation unless severe medical compromise prevents surgical intervention.[28] Surgical management varies, however, with the type and severity of fracture sustained.

2.1.1. Femoral Neck Fractures

The primary concern with a FN fracture is disruption of the blood supply to the femoral head. The femoral head blood supply enters the capsule posteriorly and fracture displacement generally occurs in a posterior direction. The degree of femoral perfusion disruption is dependent upon the amount and direction of displacement as well as the level of the fracture. Fractures occurring in the proximal neck are more likely to disrupt perfusion than those occurring more distally. A second method of perfusion disruption can occur through increased capsular pressures. If the capsule remains intact following fracture, bleeding within the capsule can create a tamponade effect interrupting the arterial supply to the head.

Because of the implications for the femoral head blood supply, this fracture type is generally classified as to the direction and degree of displacement of the femoral head.

Displaced fractures have a much greater likelihood of progressing to non-union or avascular necrosis (AVN) than non-displaced fractures. Management of a FN fracture is operative, although occasionally, compression-type fatigue fractures will be treated non-surgically if the patient can be mobilized without significant pain.[28]

Arthroplasty (hemi or total) or internal fixation (IF) with multiple screws are the most commonly used techniques in this type of fracture.[30,31] There is neither evidence nor clinical consensus as to when each of these techniques should be used with Lyon (1997) referring to FN fractures as the 'unsolved fractures'.[32]

Best current management of a femoral neck fracture when using IF is considered to be three cannulated screws in an inverted triangle.[31] With increasing age, decreasing bone stock and increased displacement or comminution of the fracture, IF becomes a less suitable treatment option. Trials comparing outcomes of IF and arthroplasty for treatment of displaced FN fractures have shown a lower complication rate and earlier return to function with use of hemi-arthroplasty (HA) or total hip arthroplasty (THA).[33-35]

The major complications of this form of treatment are non-union and AVN. Non-union has been reported to range from 4-30% dependent upon patient population and occurs earlier than AVN with more severe pain in the hip.[33-36] Factors increasing the risk of nonunion include increased age, poor bone density, increased fracture displacement, inadequate fracture reduction and position of fixation devices. AVN can occur much later after a fracture (i.e. even greater than 24 months post fracture) and may or may not require further surgery dependent upon the patient's pain and level of disability as a result of the segmental collapse. Fracture management using IF is, therefore, typically reserved for younger patients in good health who have a non-displaced fracture.

When IF cannot be used, HA is used to treat the hip fracture. First generation HA implants were the Austin Moore or Thompson prostheses, unipolar devices with a monolithic design that prevented optimal sizing for both the acetabulum and stem. Most HA devices used now are modular and offer significant advantages over the original monolithic devices. A better fit of the implant can now be obtained and if revision to THA is required, the stem does not have to be removed.

These devices can have pressfit or cemented fixation with the latter most commonly used because it achieves immediate fixation, and thus stability. The non-cemented devices have difficulty achieving mechanical stability due to decreased cancellous bone density and expanded intramedullary (IM) canals typically seen in these patients. The disadvantages to cement fixation are that it requires slightly longer operative time and if a monolithic device is used, revision to THA is much more difficult. Additionally, cardiopulmonary collapse immediate post-cementation can occur in rare instances.[30]

Dislocation of the HA has been reported to be 5% or less.[30,36] More important are the mid to late term complications of acetabular erosion or protrusio requiring revision to a total hip arthroplasty. The majority of patients have acetabular wear at mid to long-term follow-up.[36] HA fixation is generally reserved for the older population so that the implant will survive longer than the patients' lifespan. TJA is only used in this population when there is significant disease in the joint (i.e. Osteoarthritis or Rheumatoid arthritis).

In a meta-analysis of 106 published studies comparing IF to HA, Lu Yao et al. (1994) reported there was a significantly greater infection rate in the HA group, but the IF group was 2.6 times more likely to require early reoperation.[36] For severely displaced fractures, there is consensus that this group should be treated with HA, regardless of age due to the high risk for nonunion or AVN.[33-35] For undisplaced fractures, this decision is based upon surgeon preference, the patient's medical and functional status as well as their age.

2.1.2. Intertrochanteric Fractures

IT fractures occur in the well-vascularized region between the greater and lesser trochanter, structures that serve as sites of attachment for many of the muscles surrounding the hip joint. This is a transitional area between the femoral neck and shaft characterized by dense trabecular bone responsible for load transmission and distribution. The pattern of the fracture determines its inherent stability or instability and has a direct effect on 1) the surgeon's ability to achieve a stable reduction of the fracture and 2) the likelihood that loss of reduction will not occur postoperatively.[37,38]

The current management of this fracture type is use of either a compression screw slide plate, also known as a sliding hip screw (most common) or an IM device. The compression screw slide plate has produced excellent results in this population[37] with the exception of the reverse obliquity pattern. Complications of this device include loss of fixation characterized by varus collapse of the proximal segment with cutout of the lag screw from the femoral head. Loss of fixation usually arises in the first three months following surgery and is typically due to either technical error in surgery (eccentric lag screw placement, improper reaming, inadequate screw barrel engagement) or fracture/patient characteristics (inability to maintain reduction, fracture collapse leading to loss of slide plate function, severe osteopenia/osteoporosis). When this complication occurs, management options include acceptance of deformity, revision open reduction and internal fixation, or conversion to an IM device. Other complications include a malrotation deformity that can require repeat ORIF, nonunion (< 2%) and acetabular penetration or AVN of the femoral head (rare with this device).

IM Devices are more typically used to fixate unstable trochanteric fracture types.[38] Hardy et al. (1998), in a randomized controlled trial (RCT) of 100 intertrochanteric fractures in subjects greater than age 60 reported that the IM devices allowed improved mobility only in the early postoperative period.[39] She also noted that there was less screw sliding and resultant limb shortening, particularly in the unstable fracture patterns. As this device has not been used for an extended time, further research is required to delineate whether outcomes in unstable fractures are improved with IM fixation.

2.1.3. *Sub-Trochanteric Fractures*

The ST fracture represents the most distal of all hip fractures and occurs between the lesser trochanter and the isthmus of the diaphysis of the femur. The transition between the cancellous bone in the intertrochanteric region to the cortical bone in the diaphysis renders this area most attenuated in terms of cortical bone with narrowest cortical wall thickness. Fractures are usually spiral, oblique or transverse with minimal comminution. These fractures tend to occur in osteopenic bone with widened IM canals and thinner cortices. The ST fracture is the least common type of hip fracture.[38] Treatment of these fractures typically involves the use of an IM device. Complications in the ST fracture include non-union or malunion leading to shortening of the leg causing a limp.

Treatment of hip fractures requires careful consideration of not only fracture characteristics, but also patient characteristics. The decision of how to manage a femoral neck fracture, in particular, depends on careful consideration of both of these sets of factors. The fracture management is very likely to be different in a healthy, active 65-year-old individual than an inactive, osteoporotic 80-year-old patient.

2.2. Incidence of Hip Fracture

The incidence rate of hip fractures is estimated to be 98 fractures per 100,000 population, with women over 60 years representing the population at greatest risk.[40] In the United States alone, 300,000 hip fractures occurred in persons 50 years and older in 1990 and this number is predicted to increase to 512,000 by the year 2040.[40] Although hip fracture incidence varies by country and race, most countries that have investigated hip fracture incidence have reported an increase in absolute hip fracture rates, associated primarily with an ageing population.[41,42] It was estimated that 1.3-1.7 million hip fractures occurred globally in 1990 and based upon an aging population, this number could increase to 4.5- 6.3 million fractures per annum in 2050.[12,13]

Alberta reported that the incidence rate of hip fractures in females aged 65 years and older during 1996-1997 was 7.7 /1000.[43] By 2041, hip fractures in Canada are projected to increase to 88,124 per annum from 23,375 reported in 1993-94.[11]

Interestingly, some studies have suggested the projected hip fracture incidence, which was predicted to increase in absolute numbers as well as in age-adjusted numbers has failed to take into account current preventative measures such as those interventions preventing bone loss leading to osteoporosis.[44-47] However, although the age-specific rate may become static or decline, with an ageing population, there is no doubt that the absolute number of hip fractures occurring per annum will continue to increase globally for the next several decades.

2.3. Health Service Utilization

Hip fracture is a significant injury requiring medical treatment for a sustained time period. In the United States, treatment costs of all osteoporotic fractures in 1995 were estimated to be 13.8 billion dollars with approximately 63% of these costs attributed to treatment of hip fractures.[48] Brainsky estimated direct treatment costs of hip fracture were $7.3 billion in 1983 and based on increasing incidence and an ageing population, these costs could increase to $16 billion in 2040 (in 1984 US dollars).[40]

Data from Statistics Canada in 1996 indicated that hip fracture was the second leading cause of hospitalization for elderly people.[49] Following a hip fracture, patients have increased utilization of health services for at least the first year after discharge.[7,40,50] Annual costs of hip fractures in Canada are currently estimated at $650 million and are expected to rise by 2041 to $2.4 billion dollars.[5]

Fiscal restraint is a concern for hospitals and is reflected in reductions in LOS in acute care. For instance, the reduction of mean LOS for patients with hip fractures in Ontario has decreased from 29 in 1990 to 22 days in 1992.[6] In Alberta, the mean LOS in acute care for hip fracture hospital decreased from 16.7 to 13.7 days during 1994 to 1997.[43] Reduction in LOS has been accompanied by a change in discharge destination with more patients being discharged to rehabilitation settings.[43]

With trends in Alberta toward early hospital discharge and community-based care, hip fractures can result in increased financial and social pressure on patients, families, and their support networks. Moreover, poor social support likely increases the chance of becoming institutionalized, with consequent increases in economic and societal costs. Economically, a major proportion of the health costs arising from the treatment of hip fracture are attributed to the costs of subsequent long-term care.[5]

2.4. Determinants of Fracture

Several factors can increase the likelihood that a patient will have a hip fracture. Increasing age, being female, and an increased incidence of falling are predominant risk factors for hip fracture.[42,51-56] Additionally, race, geography, reduced bone mineral density (BMD), low body mass index (BMI), poor health and lifestyle choices can also lead to increased risk of hip fracture.[57-74]

2.4.1. Age and Sex

Risk for hip fracture is greater with increasing age, and higher in women than men.[10,42,51,52,54,55,63] One in three women and one in four men will sustain a hip fracture by the time they are 95 years old.[53] Ontario reported an incidence rate of 1.7/1000 men and 4.6/1000 women in 1992[6] while the incidence rate in Alberta was 7.7/1000 and 3.86/100 for females and males greater than age 65 years respectively in 1996-97.[43] In most cases, there is at least a 2:1 ratio of female to male hip fracture incidence, although in countries where the incidence of hip fracture is lower, this ratio also decreases.[43,53-55]

2.4.2. Race & Geography

Hip fracture rates vary by geography and race with the predominantly Caucasian populations of North America and Northern European countries reporting the highest incidence.[42,52] Southern European and South American countries have significantly lower hip fracture rates, in comparison to this group, as do Asian and Black populations.[42,54,57,58,61] Kanis et al. (1999) found that exposure to sunlight was an independent predictor of BMD after adjustment for other confounders.[57] This finding may help explain why Southern European countries have a lower incidence of hip fracture than the Northern Scandinavian countries.

Higher bone mass and shorter hip axis lengths in Blacks and Hispanic populations may partially account for the lower incidence rates in these groups.[72-75] Although bone mass in Asians is similar to that of Caucasians, bone volume is less, a factor that may need to be considered when examining risk of fracture.[76]

Many of the cross-national studies have used administrative databases, which may have different recording procedures and also contain limited information about individuals' characteristics. Thus, differences in lifestyles (i.e. physical activity level, dietary intake and medication use) may exist between countries and races that should be considered as factors accounting for the some of the variation seen between countries and races.[42]

2.4.3. Body Mass

It has been suggested that low body weight is associated with an increase in fracture risk as is weight loss after age fifty.[62,70,77] Several other studies, have suggested that low body weight is a non-significant predictor for hip fracture after controlling for BMD.[67,71,78]

2.4.4. Propensity for Falls

Falls are a frequent occurrence in the elderly. A fall has been defined as unintentionally coming to rest on the ground or at some lower level, not as a result of a major intrinsic event (i.e. stroke, syncope) or a major external force.[79]

It has been estimated that approximately one third of all persons 65 years and older will fall at least once each year and of these individuals, 50% will experience multiple falls within in a year.[80,81] As age increases, the incidence of falling increases, as evidenced by the 40% of persons aged greater than 80 years who fall annually.[80] For those individuals who experience a fall, 10-15% will sustain serious injury, including hip fracture.[49,80-83] Fall direction has also been suggested as a risk factor for hip fracture with patients who fall to side, landing directly on their hip being more likely to fracture than patients who fall forwards or backwards.[69] Over 90% of patients report the hip fracture occurred as a result of a fall.[79,84]

2.4.5. Preoperative Physical Activity Level

Inactivity in old age has been consistently shown in cohort studies to lead to increased risk of hip fracture.[62-65,85-87] Further, subjects who were physically inactive in previous years have an increased risk compared to those who were active in earlier years.[63,64,85,87,88]

2.4.6. Preoperative Medical Conditions

Hip fractures occur more often in persons who are medically and functionally compromised compared to their age, sex, and race-matched counterparts in the general population.[89] Poor self-rated health has been shown to predict hip fracture[62], as have hospitalizations in the year prior to fracture.[56]

Diseases that compromise gait, balance and lower extremity strength such as Parkinson's disease and prior stroke have been associated with an increased risk of fracture, as has poor vision.[60,62,81,90-92] All of these conditions lead to an increased risk of falling, the primary cause of hip fracture. Recent studies have also shown an increased risk of hip fracture in patients with end-stage renal disease (ESRD).[93,94] Renal disease leads to decreased bone mass, so that a fracture is more likely to occur following a fall.

2.4.7. Osteoporosis

Although most falls are low energy, that is a fall from standing height or lower, elderly patients often have concomitant reduced bone density.[79] Postmenopausal women, in particular, with reductions in estrogen levels are at increased risk of bone loss.[95] Low BMD or osteoporosis has been shown in several studies to be linked to increased fracture risk in all bones, with hip fracture being the most severe of the osteoporotic fractures.[62,69,71,78,96] In a meta-analyses of fracture risk studies, Marshall et al. (1996) reported the relative risk (RR) for hip fracture increased 2.6 times for each standard deviation decrease in BMD.[97]

Osteoporosis is often undiagnosed either pre or post fracture in hip fracture patients and subsequently goes untreated. A recent chart review of Edmonton hospitals indicated only 15-20% of patients admitted for treatment of hip fracture were taking osteoporosis medications on admission and even fewer were discharged on appropriate medications.[98] Other studies in North America and Europe have reported similar findings.[84,99]

2.4.8. Cognition

Decreased cognition has been shown to increase the risk of hip fracture even after adjustment for other confounders.[62,96] Patients with decreased cognition may show poor judgement regarding their physical ability leading to an increased fall risk.

Additionally, patients with cognitive impairment often use psychotropic medications. It is unclear whether it is underlying cognitive impairment leading to increased fall risk or the medications' effect altering balance reactions.[80-82,100,101]

2.4.9. Lifestyle Factors

Smoking, heavy alcohol use and caffeine are all factors suggested as risk factors for hip fracture. Additionally, living alone and lower socio-economic status have also been linked to increased fracture risk.

> ***Smoking*** has been associated with increased RR (1.1 – 2.7) of hip fracture, although the mechanism by which it occurs is unclear.[62,63,66,102,103] Lower bone mass is seen in smokers compared with non-smokers, increasing the risk of fracture with a fall.[104,105] Further, although controlling for lower body weight seen in smokers did not change the RR, adjusting for self-reported poor health attenuated the RR of smoking from 2.1 to 1.4.[62]

Alcohol Use: The relationship between alcohol use and hip fractures is inconsistent and appears to be dose-dependent. Moderate use of alcohol has been reported to be protective against hip fracture.[106-108] However, heavy use of alcohol has been found in some studies to increase fracture risk, although these studies did not control for nutritional deficiencies, which may be present in subjects consuming large amounts of alcohol.[109,110]

Caffeine Use: Cumming (1997) has suggested the caffeine source affects its influence on hip fracture risk.[10] The primary sources of caffeine are coffee and tea. Urinary excretion of calcium is increased with increased caffeine use, but tea also contains fluoride and phytoestrogens, substances protective against fracture.[10] In studies that examined these beverages separately, increased coffee consumption has been linked to increased fracture risk, while increased tea consumption has been linked with decreased fracture risk.[62,63,110]

Socio-economic Status as defined by occupation, current employment, income level and housing type was examined in a case-control study undertaken in Sweden.[68] In subjects with similar comorbidities, those subjects who were gainfully employed, had a higher income level and lived in a house were less likely to fracture their hip than those who were not employed, had lower incomes and lived in multi-family dwellings.

Married individuals are less likely to sustain a hip fracture than those who live alone.[68] Several other studies have reported that living with a partner has a positive effect on health and longevity even in the absence of a hip fracture.[111-113]

2.4.10. Residential Status

Institutionalized subjects also have an increased incidence of hip fracture compared to community-dwelling individuals.[51,114] Norton (1999) reported RR for fracture of 2.5 in institutionalized compared to community dwelling persons even after controlling for confounding variables.[114] Institutionalized subjects are generally those with impaired cognition and/or physical health putting them at increased risk for falling and thus, hip fracture.

2.5. Determinants of Outcome

Following a hip fracture, subjects are at increased risk of 1) loss in functional independence, 2) requiring LTC and 3) mortality. Limited evidence also suggests that HRQoL may also be negatively affected by a hip fracture.[115-117] Pre fracture characteristics such as 1) sex, 2) age, 3) pre fracture functional ability and level of independence, 4) cognition and 5) pre-existing medical conditions will often significantly affect the patients' post fracture recuperation.[1-3,89,118-122] Additionally, postoperative complications arising from the fracture-stabilizing device, surgical procedure or pre-existing co-morbidities may also adversely affect patients' recovery.[123-126]

Because many of these outcomes cannot be studied using randomized study designs, the majority of evidence available is from risk-adjusted cohort studies. Studies are heterogeneous in terms of 1) determinants chosen to predict outcomes and 2) measurement of the outcomes themselves. Thus, although there is a plethora of articles available on outcomes and their predictors in this fragile patient population, the variability in predictors examined and outcomes assessed makes the summary of available evidence difficult.

2.5.1. Determinants of Functional Recovery & Ambulation

The level of function regained following a fracture is dependent on pre fracture function, age, fracture location, mental status and social supports.[1-4,21,89] Wolinsky et al. (1997) reported that the greatest functional gains occur within the first four to six months post fracture[127] although Magaziner et al. (2000) indicated that functional recovery in the lower extremity can take up to one year.[128]

Rehabilitation is an integral component of recovery, as patients must regain a post-fracture functional level allowing them to be independent in ADL if they are to return home. Unfortunately, the majority of patients who return home do not regain their pre fracture level of function.[23,117,127,129,130,130]

> ***Age***, but not sex has been found in several studies to be predictive of functional recovery following fracture.[2,3,125,131,132] Functional ambulation after a hip fracture has been reported to vary between 41% and 97%, and is age dependent. Recovery of ADL function is observed more frequently in younger patients with good cognition.[23,89,118]
>
> ***Pre fracture Functional Level*** as measured by the patients' ability to ambulate and perform ADL independently prior to the fracture is also strongly correlated with how well the patient will recover following fracture.[2,23,132-134] Patients who are more dependent pre fracture are less likely to regain a similar

functional level post fracture than those functioning independently prior to their fracture.

Mental Status: Acute confusional states in elderly hip fracture patients during hospitalization are highly prevalent (25%-73.5%) and strongly correlated with higher rates of functional dependence.[3,135,136] Patients with cognitive impairment typically have delayed mobilization and rehabilitation primarily related to their inability follow instructions.[135] However, recent studies have shown, given appropriate rehabilitation following fracture, cognitively impaired subjects can attain similar functional gains as seen in cognitively intact patients.[134,137,138]

Depression is also common following hip fracture and has a negative impact on recovery. Patients with persistent depression for two months following hip fracture exhibited poorer recovery than subjects whose depression resolved or those who did not display depressive symptoms.[4,139]

Type of Hip Fracture: Patients who sustain an IT fracture are less likely to return to their pre fracture level of function than those who sustain a FN fracture.[21,23] The difference in postoperative recovery between fracture types remained even after adjustment for age, and pre fracture function.[21] This finding may be related to the accuracy of reduction and subsequent surgical fixation of the fracture.

Social support has also been found to be a predictor of how well a patient will recover following fracture. Cummings et al. (1988) found that social support remained an important predictor for return to pre fracture functional levels even after adjustment for age and mental status.[140] More important than quantity of support, Mutran et al. (1995) found support from people close to the patient was an important predictor of regaining functional independence following a fracture.[131] Depression was more commonly seen in patients with minimal social support.[2]

Returning to a similar level of independence following a hip fracture is of great importance to patients. Quality of life has been noted to be compromised following hip fracture with some patients perceiving a hip fracture as worse than dying or 'the beginning of the end'.[9,141] Finding methods of rehabilitation that promote maximal functional recovery and independence in patients has significant implications not only to the patients, but also to their caregivers and health care providers.

2.5.2. Determinants of Institutionalization

At one year following fracture, the rate of return home after fracture varies from 50% to 75% with the remaining patients requiring long-term institutionalization.[142] The most significant predictor of institutionalization following hip fracture is altered mental status.[117,124,127,129,143] Increasing age, and dependence in pre fracture function and ambulation have also been suggested as predictors of requiring institutional care.[124,144-147] Finally, individuals who live in rural regions are more likely to be institutionalized following fracture than those who live in urban settings.[148]

Dementia and delirium are predictors of extended nursing home placement as patients with decreased mental status are less likely to achieve independence in ambulation and ADL.[117,124,129,145] Patients may make similar gains in function as non-impaired subjects, but be unable to live independently because of reduced judgment and decision-making capacity.

Increasing age has also been associated with increased likelihood of institutionalization. [129,145,147] Koval et al. (1996) reported that patients less than 85 years of age were 2.5 times more likely to be able to return to independent living than those older than 85 years.[147]

Dependence in ADL and Ambulation prior to fracture has also been linked to nursing home placement following hip fracture.[129,146,147] Those patients who were independent in all basic ADL activities were 6.75 times more likely to return to the community than those who were dependent in basic ADL.[147] Further, non-ambulatory patients at time of discharge from the surgical hospital were 1.4 times more likely to require long-term care than those who were ambulatory.[147]

Rural residents were more likely to require long-term care following a hip fracture than their urban counterparts in a study of administration data from Maine, United States of America (USA).[148] These researchers noted that home care was less available in the rural areas and postulated patients were more likely to be placed in extended care because appropriate care could not be offered in the community.

An inability to return home following a hip fracture has high social and financial consequences. Loss of independent living is one of the biggest fears reported by elderly subjects.[9] Further, long-term care placement has significant ramifications to healthcare providers in terms of both service utilization and costs.[5]

2.5.3. Determinants of Mortality

Mortality following a hip fracture has been reported to vary from 18 to 33% at one year.[8,121,146,149-151] The greatest excess mortality occurs within the first 6 months after a hip fracture.[8,127,146] When adjusted for age, education, comorbidity and functional status, the number of excess deaths attributable to hip fractures in Caucasian women seventy years and older has been reported at 4 per 100 hip fracture patients during the first year following hip fracture.[8]

Risk factors that increase the probability of mortality following a hip fracture include increasing age, male sex, cognitive impairment, multiple medical comorbidities, dependence in ADL, and limited walking ability pre fracture.[8,43,120,129,132,149-155] Further, the presence of malnutrition or anaemia on admission, significant delay in performing surgical fixation or the use of general anaesthetic have also been suggested as risk factors for mortality in this patient group.[124-126,132,149,150,156,157]

> ***Age and Sex:*** In patients greater than 65 years of age, Myers et al. (1991) reported that the risk of death doubled for both males and females with each five-year increment in age.[154] Several other studies have reported similar findings.[8,132,150,151,153] Males are, however, at significantly higher risk of dying than females regardless of age.[43,121,149,152,154] Jacobsen (1992) reported that although mortality was higher for black women than white women, mortality for men was higher than either group of women and similar across races.[121] Chariyalertsak (2001) noted that even after multivariate risk adjustment, the Hazard Ratio (HR) for mortality was 2.0 for men compared with women.[152] Other studies reported with adjustment for the presence of comorbid conditions,

the mortality difference between men and women was reduced, but not eliminated. This finding lends some support to the hypothesis that men who break their hip are more likely to have comorbid conditions than similar aged females. However, uncertainty remains regarding what other factors may account for higher mortality in men.

Comorbidities: The risk of dying following hip fracture has also been noted by several researchers to increase in the presence of multiple medical conditions.[8,129,150-152,154,155] Myers (1991) reported patients with cardiac, neoplastic and cerebrovascular disease were at increased mortality risk[154] while others have noted having greater than two chronic illnesses on admission increased the likelihood of dying following fracture.[129,152,155] Nutritional status of the frail elderly population has also been found to be a determinant of mortality after a hip fracture. Malnutrition, as diagnosed by low levels of serum albumin, is associated with increased in-hospital mortality.[118,156]

Cognitive impairment has also been linked to mortality following hip fracture even after adjustment for comorbidities, age and sex.[129,150,155] Holmes (2000) reported an adjusted RR of 2.78 and 2.76 for patients with dementia and delirium respectively in comparison to those patients without cognitive impairment.[150]

Pre fracture Functional Level: Patients who were more dependent in ADL prior to fracture are more likely to die following a hip fracture.[21,89,152,155] Hannan et al. (2001) observed ambulating prior to hip fracture was protective against mortality reporting an odds ratio (OR) of 0.86 (95% confidence interval (CI) 0.8-0.94) for ambulators compared to non-ambulators.[132] Further, these researchers observed that patients who had a paid helper at home prior to their fracture were two times as likely to die as subjects who were independent in ADL.

Delay in surgical fixation has also been linked to mortality in this patient group. Because a randomized clinical trial is not considered feasible, only cohort studies with risk-adjusted outcomes are available to determine best practice. The cohort studies have been variable in their definition of delay in time to surgery.[124,125] Hamlet et al. (1997) reported an increased RR of 2.2 for mortality at one year if surgery was delayed beyond 24 hours, even after adjusting for preoperative severity of illness.[125] Hoenig et al. (1997) defined surgical delay as greater than 48 hours from hospital admission. In their study, when looking at the patients who were most ill on admission, early surgical intervention significantly reduced major medical complications compared to ill patients who waited beyond 48 hours for surgery.[124]

Postoperative complications are also linked to mortality following a hip fracture.[158-160] Myers et al. (1991) and Marotolli et al. (1994) each reported a doubling of mortality in patients who reported postoperative complications when compared to those with an uncomplicated postoperative course.[129,154] Hamlet et al. (1997) indicated the increased risk for mortality following a major cardiopulmonary postoperative complication continued for at least one year following fracture.[125] Complications following surgery may also be associated with the type of anaesthetic used. A large systematic review of anaesthetic practice reported clear benefits to using regional over general anaesthetic.[126] Although the review included several surgical procedures, a large proportion of the study populations were elderly patients with hip fractures. This review demonstrated a one third reduction in mortality as well as a reduction in morbidity as measured by decreases in 1) deep vein thrombosis (44%), 2) pulmonary embolism (55%), 3) transfusion requirements (50%), 4) pneumonia (39%) and 5) respiratory depression (59%) with use of regional anaesthetic.

Mortality is a frequent outcome following hip fracture in elderly patients. This patient population is often in fragile health prior to the fracture, and subsequently at risk for mortality from several causes. Reducing mortality following hip fracture will require a multi-factorial approach to determine 1) which risk factors are modifiable, and 2) how these factors can be readily identified and treated.

2.6. Instruments

2.6.1. Mini Mental Status Examination (MMSE)

The MMSE is a simple scored form that examines cognitive mental status through administration of an 11-item questionnaire. The contents of this instrument can be placed into two major divisions. The verbal division (21 points) evaluates orientation, memory and attention while the performance division (9 points) evaluates reading, writing and constructional abilities.[161]

Different scores have been suggested as "cut-off" scores for detecting probable cognitive impairment with most studies proposing scores lower than 22-23 as indicative of reduced cognition.[162,163] This is the score that best balances the sensitivity (0.87) and specificity (0.82) for clinical applications.[162]

The MMSE is affected by both age and education with older patients and those with less education scoring lower than subjects younger than 60 and those who have greater than a Grade Eight education.[161-164] Anthony et al. have suggested for individuals greater than age 60 that the cut-off score be set at 22, with those scoring below that level considered as cognitively impaired.[162]

The test-retest reliability has been reported at 0.85 for subjects without dementia and 0.90 for subjects with dementia.[162] This questionnaire has also been previously validated and is widely used to assess cognitive status, taking approximately 5 minutes to administer.[162,165,166]

2.6.2. Barthel Functional Index (BFI)

The Modified BFI was designed to measure improvement in ADL in geriatric patients with physical dysfunction.[167] The activities measured include eating, grooming and toileting as well as a mobility component that examines transfers (bed/wheelchair/toilet), walking and stair climbing. There are ten different basic ADL skills, each of which is rated as "independent", "needs assistance" or "unable". These responses are then summed to a total score that ranges between 0 and 100 with higher scores indicating better functioning.

The BFI is a self-report assessment in which patients report what they believe their ability is to perform each of the tasks rather than an actual performance assessment. In a study of 182 elderly respondents who did both self-report and performance assessments, Myers et al. (1993) reported that self-assessments were not inferior to actual performance measures although there was a tendency to underestimate difficulty of tasks by subjective assessment.[168] However, it would not be expected that patients would differently report their abilities between the two cohorts studied here.

The BFI has been extensively used in geriatric populations and has demonstrated good interrater reliability and criterion validity when compared to other scales that assess ADL.[169,170] It has been shown to be more responsive than the Katz Index, but less so than the Functional Independence Measure (FIM) or the Kenny Self-Care Evaluation.[171,172]

Further, the BFI has also been demonstrated to be reliable whether it is administered in-person or by telephone. Korner-Bitensky et al. (1995) reported an intraclass correlation coefficient of 0.89 when comparing these two modes of administration.[173] Comparison of patient versus proxy respondents has been reported to have a good level of agreement when analyzed using the Kappa statistic (K = 0.75).[173] Thus, the BFI is an appropriate instrument for the purposes of this study and is simple to use requiring only five to ten minutes to administer.

2.6.3. RAND-12 Health Status Inventory (RAND-12 HSI)

The RAND-12 HSI is a generic health status questionnaire consisting of 12 items that takes less than five minutes to complete.[174] It is derived from a longer 36-item questionnaire. The shorter questionnaire is considered more appropriate for the elderly population as a high level of item non-response has been reported with the longer version in this population.[175,176] In a community-based study of 541 respondents greater than age 65, the questionnaire was completed in its entirety by 95% of the participants.[177] Further, 88% of these respondents indicated that they found the questionnaire acceptable to complete.

The RAND-12 HSI is identical in content and format to the Short Form-12 (SF-12), a copyright version of the questionnaire distributed by Quality Metric Inc, which has strict formatting and scoring regulations. The RAND version differs from the copyright version only in the scoring system. In both scoring systems, two summary scores are generated for the questionnaire, one reflecting a physical health summary score and the other, a mental health summary score. The SF-12, however, uses all 12 items to obtain both mental and physical summary scores. Neither of the summary scores can be calculated if a single response is missing. In contrast, the RAND-12 HSI uses only the six items most highly weighted on the each of the factors, mental or physical health, to obtain the summary scores. Thus, the Physical Health Composite (PHC) score can be calculated when there are missing responses to a mental health question and the Mental Health Composite (MHC) score can be calculated when there are missing responses to physical health questions. In our study, using the RAND scoring system allowed us to retain several more subjects' data than if we had used the SF-12 scoring system.

In studies comparing patient and proxy responses to HRQoL measures, only fair agreement was reported, with the proxy over-estimating impairment and under-estimating HRQoL compared to the patient.[178-180] Thus, adjustment was undertaken for scores calculated using proxy respondents.

2.6.4. TyPE Hip Specification Questionnaire

This instrument is a one-page questionnaire that evaluates lower limb physical function and hip pain status.[181] It was designed by the Health Outcomes unit to be an easily administered tool to evaluate outcomes following hip fracture as well as to determine pre fracture lower extremity and hip pain. Items regarding pain and activity level were utilized as predictors of functional recovery and institutionalization in the analysis.

2.6.5. Older American Resources and Services (OARS) Social Support Scale

The OARS Multidimensional Functional Assessment Questionnaire Part A measures functional ability in five domains: social and economic resources, mental health, physical health and self-care capacity. For this study, only the Social Resources component that was modified at McMaster University for Canadian use was administered to determine the subjects' social support.[182] Specific items of the social resources component measuring levels of social support and contact were utilized as predictors of functional recovery and institutionalization.

2.6.6. Charlson Comorbidity Index

The Charlson comorbidity index is a weighted index that takes into account both the number and severity of comorbid conditions. It was developed from an inception cohort of 604 medical patients in 1984.[183] Weights for comorbid conditions were derived from adjusted RR obtained through regression analysis that examined predictors of mortality. Conditions with an RR of <1.2 were dropped from the index. Conditions with an RR ranging from >1.2 to <1.5 were weighted as "1"; conditions with RR ranging from ≥1.5 to < 2.5 were assigned a weight of "2"; conditions with weights between 2.5 and 2.5 were given a weight of "3". Only two conditions, Acquired Immune Deficiency Syndrome and metastatic solid tumor had adjusted RR of greater than six and were, thus given a weight of "6".

Nineteen conditions were identified as increasing mortality risk with ten conditions being assigned a weight of one, six being assigned a weight of two, one a weight of three and the two aforementioned conditions being weighted as six. Index scores are obtained through summing the weights of the specified conditions and then categorizing them as "0", "1-2", "3-4" and "5 or greater" with the higher numbers indicating increased risk of mortality.

The Index was validated in a second inception cohort of breast cancer patients and was found to predict mortality in this group as well. Bravo et al. (2002) investigated the prognostic value of the Charlson comorbidity index when it was applied to elderly individuals living in long-term care and found it to reliably predict mortality in this group.[184]

Table 2.1 Characteristics of Fracture Type and Methods of Surgical Fixation

Primary Author (Ref #)	Date Published	Study Design	N	Purpose Of Study & Outcomes Evaluated	Findings	Level Of Evidence
Fox KM (21)	1999	Prospective cohort of patients aged ≥ 65 years admitted with hip fracture	923	Identification of characteristics leading to fracture; Examination of risk-adjusted survival and recovery by fracture type	No gender difference between fracture type; Increased dependence in ADL prior to fracture in FN; Increased number of comorbidities in IT; Similar mortality; IT had increased LOS & less likely to return to pre fracture functional level	2
Fox, KM (22)	2000	Prospective cohort (Study of Osteoporotic Fractures (SOF)) of women ≥ 65 years	9704 (501 hip fractures)	Incidence of FN and IT fracture using Cox regression	FN fractures are predicted by BMD and poor functional status; IT fractures are predicted by poor health status.	2
Koval KJ (23)	1996	Prospective cohort of community-dwelling subjects 65 years and older admitted with hip fracture	680	Determine if demographic profile is different for subjects with IT compared to FN fractures	After adjustment for age, in women IT fractures occurred in older subjects who were limited to home ambulation and more dependent in ADL	2
Mautalen CA (24)	1996	Review of literature on etiology or FN and IT fractures	NA	Determine if patients who sustain FN or IT fractures have different physical characteristics	Patients with IT fractures have lower BMD, particularly at the trochanter level, are older, thinner and shorter than those who sustain FN fractures	3
Michaelsson K (25)	1999	Population-based case-control study of Swedish women 50-81 years old admitted with hip fracture compared to age-matched controls	1,294	Identification of fracture risk by fracture type using risk adjustment	FN fractures occur with increasing height (OR = 1.23 (95%CI: 1.15-1.32) for every 5cm increase; current Hormone Replacement Therapy (HRT) was protective for both types, but former HRT only protective for IT fractures (OR= 0.55 (95% CI: 0.33-0.92))	2
Baudoin C (26)	1993	Meta-analysis of 16 studies examining the ratio of FN to IT fractures at different ages	36,451	Determine the FN/IT ratio in men and women <50, 50-59, 60-69, 70-79, ≥ 80	FN/IT ratio is greater than 1 in women until age 90 where it is 1; Ratio is 1 in men. Men had increased fracture risk prior to 50; Women had greater risk from 50- 80	1

Karagas MR (27)	1996	Review of Medicare data from USA population aged 65-99	34,243	Determine hip fracture type by age, sex, race and geography	Rate of hip fracture increased with age in both sexes and all races. Rate of IT fractures increased with age in white women only. More fractures occurred in the Southern than Northern states in women.	3
Parker MJ (28)	2001	Cochrane Systematic Review (CSR) of RCT of conservative versus operative treatment (n = 5 studies)	428	Compare mortality; Complications, Anatomical restoration and final outcome	Shorter LOS and improved anatomical restoration with operative treatment, No difference in mortality or complications or final outcome	1
Parker MJ (30)	2002	CSR of RCT's of Arthroplasties for FN fractures (n = 13 studies)	1,464	Compare fracture fixation complications; postop complications	No difference between unipolar, bipolar HA and THA; Uncemented HA or THA associated with decrease in function; Increased revision in HA; Increased dislocation in THA	1
Parker MJ (31)	2002	CSR of RCT's of IF for FN fractures (n = 27 studies)	5,269	Compare fracture fixation complications; postop complications	No advantage to different methods of fixation other than the most commonly used multiple screws.	1
Tidermark J (33)	2003	RCT of IF compared with THA for displaced FN fractures of community-dwelling functionally independent subjects	102	Compare complications (re-operations, limb shortening), Function; HRQoL	Increased failure of IF at 2 years (36% IF versus 4% THA); Hip function significantly better at all postoperative assessments; Better HRQL in THA	1
Parker MJ (34)	2002	RCT of patients > age 70 receiving either IF or HA for displaced FN fractures	455	Compare complications (re-operations, limb shortening), Mortality and Function	Increased re-operation in IF; No difference in mortality at one-year; Pain and mobility similar at three years; Increased limb shortening with IF	1
Rogmark C (35)	2002	Multi-centre (n =12) RCT of IF versus THA and HA for displaced FN fractures in subjects > age 70	409	Compare complications (re-operations); Two-year functional outcome; Mortality.	Increased failure of IF at 2 years (43% IF versus 4% THA); Improved function in THA and HA; No difference in mortality	1

Lu-Yao G (36)	1994	**Meta-analysis of HA and THA versus IF in displaced FN fractures (n = 106 studies)**	20,169	Examine function (pain and mobility); Mortality; 2-year reoperation rate; Complications	No difference in mortality; 2-year reoperation rate for IF was 20-36%; Most common complication of IF was non-union and AVN; Reoperation rate for HA/THA was 6-18%; Most common complication was dislocation; Decreased pain with HA/THA; No difference in function	1
Parker MJ (37)	2002	CSR of RCT's of IF for IT fractures (n = 10 studies)	1,856	Determine fracture complications and postoperative complications	Sliding hip screw offers best management of IT fractures with exception of reverse obliquity fractures.	1
Parker MJ (38)	2002	CSR of RCT's of IM Nails for IT fractures (n = 26 studies)	3,600	Determine fracture complications and postoperative complications	No advantage to using IM nails in IT fractures; May be an advantage in reverse obliquity and sub-trochanteric fractures	1
Hardy DCR (39)	1998	RCT of IN to IF for IT Fractures	100	Determine operative time, Postoperative complications; mortality postoperative mobility	Increased operative time with IN; Improved early mobility with IN, but no different at one-year; Decreased loss of reduction in unstable fractures	1

Table 2.2 Incidence of Fracture and Health Service Utilization

Primary Author (Ref #)	Date Published	Study Design	N	Purpose Of Study & Outcomes Evaluated	Findings	Level Of Evidence
Brainsky A (40)	1997	Prospective cohort study of community-dwelling patients ≥ 65 years who sustained a hip fracture	759	Costs (direct medical care, formal non-medical care and informal care); Health service utilization in the years before/after fracture using standardized costs	Significantly increased costs in the year following the fracture; Mostly attributable to hospitalizations, nursing home stays and rehabilitation services	2
Kannus P (41)	1996	Review article of epidemiological studies of hip fracture incidence	Not applicable	Review reported hip fracture incidence from specific geographic regions	Crude hip fracture incidence is increasing globally; age-adjusted is increasing in some regions and leveling off or reducing in others.	4

Maggi S (42)	1991	Meta-analysis of global fracture incidence rates of subjects > 50 years old (n = 33 studies)	Approx 3 million	Age, sex and geographically adjusted hip fracture incidence rates	Incidence rate increases with age in all regions; Ratio of female to male is higher in whites, but an be reversed in other races; Incidence higher in Caucasian than black, Hispanic or Asian; Asian rates increasing	3
Cooper C (12)	1992	Review article of studies of hip fracture incidence	Not Stated	Determine incidence of hip fracture globally and predict future incidence rates	1990 global rates estimated to be 1.66 million; Projected hip fracture rates in 2050 is 6.25 million; Major global demographic changes will see fracture incidence increase significantly in Asia and Latin America.	3
Gullberg B (13)	1997	Review article of studies of hip fracture incidence	Not Stated	Determine incidence of hip fracture globally and predict future incidence rates	1990 global rates estimated to be 1.26 million; Projected hip fracture rates in 2025 is double and in 2050 is 4.5 million; Major demographic changes will see fracture incidence increase significantly in Asia.	3
Maxwell CJ (43)	1999	Population-based retrospective age, sex and health region stratified review of hip fractures in Alberta (1994-1997)	5,352	Health service utilization (LOS) in hospital, re-admissions, nursing home admissions); Mortality; Predictors of fracture	LOS decreased between 1994 and 1997; Mortality was no different over time; increased numbers of fractures particularly women > 85 years.	3
Papdimitropoulos EA (11)	1997	Population-based retrospective age and sex-stratified review of hospital discharge data from the Canadian Institute of Health Information	Not Stated	Determine incidence of fracture, mortality, health service utilization (LOS), Comparison of men and women used determine current and projected rate of hip fracture in Canada	Hip fractures increased exponentially with age, particularly in women; Increased mortality in men	3

Kannus P (44)	1999	Retrospective review of National Hospital Discharge Register's hip fracture patients compared to a population with direct standardization to a mean Finnish population between 1970 and 1997	Not stated	Determine if age-adjusted hip fracture incidence was changing between 1970 and 1997	Reported an increase in both absolute and age-adjusted hip fracture incidence, particularly in patients 75-84 and ≥ 85 years	3
Huusko TM (45)	1999	Population-based cohort of patients > age 50 with and without hip fracture in Central Finland	451,956 668 hip fractures	Determine if age – adjusted incidence of hip fracture changed over 10 years	No change in age-adjusted hip fracture incidence; Significant change in age distribution from 18% to 30% of hip fracture population being ≥ 85; 11% absolute increase in number of hip fractures	3
Lofman O (46)	2002	Review of radiologic register from 1982-1996 in Sweden	Not stated	Determine if actual incidence of fracture was similar to that which had been predicted	FN/IT ratio has leveled off and Female/Male ratio has declined; Rates in women and men are now projected to decrease by 19 and 7% respectively by year 2010. Men may experience increase in IT fractures. With aging population, annual hip fracture numbers should remain stable with current numbers	3
Fielden J (47)	2001	Retrospective review of administrative database to identify hip fractures occurring in New Zealand between 1988-1999	Not Stated	Determine actual incidence rate of hip fracture compared to that predicted in 1990.	Numbers of hip fractures were 20% less than predicted in 1999. Age-adjusted rates show a significant reduction in fracture incidence in women ≥ 85.	3
Ray NF (48)	1997	Retrospective review of 1995 USA administrative database of subjects ≥ 45 years admitted with osteoporotic fracture (as determined by an expert panel using a modified Delphi consensus technique)	432,448 246,495 hip fractures	Determine direct medical costs associated with treatment of osteoporotic fractures	Health care expenditures were rated at \$13.8B; Hip fracture costs were estimated to be \$8.7B; Majority of cost was for inpatient stay, followed by nursing home care	3

Wilkins K (49)	1999	Retrospective review of National Population Health survey in Canada to determine costs associated with fall-related injuries	13,363	Risk-adjusted assessment of association between injurious falls and entry into LTC	After controlling for age, decline in independent function, increased odds of entry into LTC (OR= 3.0)	3
Donald IP (50)	1999	Longitudinal prospective cohort study examining outcomes in patients who fall over a four-year period	1,815	Risk-adjusted assessment of association between falls and mortality and admission to LTC	Recurrent fallers were at increased risk of mortality (OR = 2.6); Both recurrent and single falls were associated with increased risk of entry to LTC (OR = 4.5 and 3.8 respectively)	2
Wiktorowicz ME (5)	2001	Prospective cohort study of hip fracture patients aged ≥ 50 years in Canada	504	Health service utilization (LOS in acute, rehab and LTC; Costs associated with treatment and care using risk-adjusted analysis	Initial hospitalization accounted for majority of cost; Increased costs were associated with LTC, age and survival; Current annual costs of hip fractures estimated to be 650M and estimated to increase to 2.4B by 2041	2
Jaglal SB (6)	1996	Retrospective study of administrative data of patients 50 years and older admitted with a hip fracture in Ontario (1981-1992)	93,660	Health service utilization (age-adjusted LOS, discharge destination); In-hospital mortality; Age-standardized hip fracture rates/1000	Rate was 3.3/1000 with no change over study timeframe, but an increase in absolute rates due to population aging; No change in mortality; Mean LOS decreased from 28.6 to 22.2 days	3
Haentjens P (7)	2001	Prospective cohort study of matched pairs of women > 50 years	159 pairs	Costs associated with hospitalization and first year following a hip fracture compared to costs associated with patient without hip fracture	Increased excess cost associated with hip fracture was $7300 USD; Largest cost differences associated with nursing home and rehabilitation stays	2

Table 2.3 Fracture Determinants

Primary Author (Ref #)	Date Published	Study Design	N	Purpose Of Study & Outcomes Evaluated	Findings	Level Of Evidence
Ooms ME (51)	1994	Retrospective review of administrative data to determine incidence rate of hip fracture in Amsterdam	649	Age, sex and resident- adjusted incidence rates using stepwise logistic regression	In the independent elderly risk of fracture doubled with each 5-year increment of age; Women higher risk than men (RR = 1.7); Increased risk in institutionalized elders	3
Bacon WE (52)	1996	Retrospective review of administrative databases from 9 countries (Canada, Chile, Finland, Hong Kong, Scotland, Sweden, Switzerland, USA, Venezuela)		Comparison of hip fracture rates among countries adjusting for age and sex	Rates increased with age and were higher in women than in men for all 9 countries; After adjustment for case definition, rates were similar in European and North American countries, higher in Hong Kong and lower in Venezuela and Chile	3
Jacobsen SJ (53)	1990	Retrospective review of USA administrative database of hospital discharges of hip fracture patients (1984-1987)	745,435	Determine race, age and sex specific incidence rates of hip fracture	Hip fracture increases with age in all races and both genders; Occurs most commonly in Caucasian women	3
Kellie SE (54)	1990	Retrospective review of administrative database from Illinois (1980-1982)	19,070	Age, race and sex adjusted fracture incidence rates	Rates were highest for Caucasian women, followed by Caucasian men, black women and black men; Increasing incidence with age; Caucasian women ages 65-85 had two times the fracture risk of Caucasian men	3
Singer BR (55)	1998	Prospective incidence study using administrative data of fractures in adult Scottish population	15,293 fractures	Determine the influence of age and gender on fracture determinants	With increasing age, subjects more likely to fracture, starting with increased wrist fractures from age 49 onwards in women. Elderly patients (> age 60) most likely to sustain hip fracture, particularly women compared to men (OR = 1.9)	2

Wolinsky FD (56)	1994	Prospective cohort study of subjects from the Longitudinal Study on Aging (LSOA)	7,527	Assess the risk of fracture in older adults	368 respondents experienced hip fracture; Risk factors were increasing age, female gender, Caucasian race, hospitalization in year prior to fracture, previous history of falling, low BMI	2
Kanis J (57)	1999	Case – control study of men ≥ 50 years from 6 countries (Portugal, Spain, France, Italy, Greece and Turkey) (Mediterranean Osteoporosis Study (MEDOS))	730 hip fractures 1132 controls	Determine risk factors for hip fracture in men	Body Mass Index (BMI), leisure exercise, exposure to sunlight and consumption of tea and alcohol remained significant predictors of fracture after multi-variate analysis	2
Lauderdale DS (58)	1997	Prospective follow-up of Medicare files of patients ≥ 65 years from January 1992 to December 1993	293,236 346 fractures in Asian-Americans	Determine hip fracture incidence in this Asian-Americans compared to other races	Age-specific incidence rates for all Asian-Americans were lower than for Caucasian-Americans; Chinese-American were lower than either Japanese or Korean- American	2
Schwartz AV (59)	1999	Cross-national study of hip fracture incidence (Beijing, Budapest, Hong Kong, Porto Alegro, Reykjavik)	7,607	Determine hip fracture incidence in these 5 region; Determine accuracy of administrative records with information retrieved directly from a chart review	Estimated incidence rates vary widely with Beijing being lowest and Reykjavik the highest; Women incidence rates higher than men in all regions except Beijing; Chart reviews identified under-reporting, but not to a degree that changed incidence differences among countries.	3
Johnell O (60)	1992	Retrospective review of administrative databases from 17 European countries		Comparison of hip fracture rates among countries adjusting for age and sex	Rates increased with age and were higher in women than in men for all countries although the ratio changed significantly between countries; Rates were highest in Northern Europe and lowest in Mediterranean countries.	3
Johnell O (61)	1992	Population-based retrospective case-control study of Parkinson's patients	64/74 Men/ Women pairs	Determine risk of fracture in patients with Parkinson's disease	At entrance to study, cases 32% more likely to have had a fracture; greatest increase in risk was for hip fracture; 27% of cases had a hip fracture	3

Cummings SR (62)	1995	Prospective cohort of community-dwelling Caucasian women ≥ 65 years followed for 4 years	9,516 192 hip fractures	Determine risk factors for hip fracture through multi-variate analysis	After age-adjustment, maternal history of hip fracture, previous fracture, low BMD, self-rated poor health, increased caffeine, poor mobility and increasing numbers of risk factors increased fracture risk.	2
Johnell O (63)	1995	MEDOS case-control study of hip fractures in women ≥ 50 years from 14 centres in 6 countries in Southern Europe	5,618 2,086 cases 3,532 controls	Determine common risk factors for hip fracture	Multivariate analysis showed late menarche, poor mental score, low BMI; low activity level; decreased sunlight exposure; decreased calcium and tea consumption	2
Grisso JA (64)	1997	Case-control study of men ≥ 45 years from USA	758 356 cases 402 controls	Identify risk factors for hip fracture in men	Low BMI, lower extremity dysfunction, psychotropic drug use, smoking increase risk; Previous physical activity was protective against hip fracture.	2
Cumming RG (65)	1994	Population-based case-control study of subjects ≥ 65 years with and without hip fracture from Australia	416 209 cases 207 controls	Determine risk factors for hip fractures in the elderly	Smoking, low BMI, weight loss increased risk; No difference in risk with HRT use; Current and previous physical activity decreased risk.	2
Michaelsson K (66)	1995	Case-control study nested in a cohort; cases were subjects who had a hip fracture; controls were matched for age and country	1,140 247 cases 893 controls	Examined risk factors for hip fracture including diet, smoking, physical activity, low BMI and previous wrist fracture	Smoking, diabetes, low physical activity, low BMI and previous wrist fracture were all associated with increased fracture risk	2
Ensrud KE (67)	1997	Longitudinal cohort study (SOF) of non-black ambulatory women ≥ 65 years in USA	8,011 236 hip fractures	Determine how body size and BMD affect risk of hip fracture	Subjects with small body size were at increased risk of hip fracture, but NOT after controlling for BMD; Patients with small body size had lower BMD	2
Greenspan SL (69)	1998	Prospective case-control study of ambulatory male and female residents ≥ 65 years from a single LTC facility	132 32 cases 100 controls	Determine how fall characteristics, BMD, function and body size affect risk of hip fracture	Subjects who fractured their hip were more likely to fall sideways (OR= 5.6; 95% CI: 1.7-18) and have an low BMD (OR= 1.9; 95% CI: 0.97-3.7)	2

Langlois JA (70)	1998	Longitudinal cohort study of the New Haven Established Populations for Epidemiological studies (EPESE) of community-dwelling white men ≥ 67 years	2,413 72 hip fractures	Determine how weight change affects risk of hip fracture	Weight of ≥ 10% was associated with increased fracture risk, but was also an indicator of poor health, physical disability and low mental status. Weight gain of >10% was borderline protective against hip fracture	2
Margolis KL (71)	2000	Longitudinal cohort study (SOF) of non-black ambulatory women ≥ 65 years in USA	8,059 326 hip fractures	Determine if body size predicts hip fracture	When controlling for BMD, body size did not predict fracture; In the absence of BMD measurements, low body weight is associated with increased fracture risk	2
Kleerekoper M (72)	1994	Prospective cohort study of random sample of postmenopausal white and black women aged 55-75	362	Examine relationship of BMD of radius, spine and femur between black and white women	Black women had greater BMD than white women of similar age.	2
Looker AC (73)	1995	BMD testing of a representative sample of American men and women ages ≥ 20 years	7,116	Age, sex and race-adjusted BMD levels of proximal femurs	BMD decreased with age, particularly in Ward's triangle; BMD was lower in women compared to men; BMD higher in Non-Caucasian groups	2
Villa MC (74)	1995	Prospective longitudinal cohort study of Mexican-American Caucasian women	152	BMD, nutritional status, mobility and falls to assess fracture risk	BMD not significantly different than reported Caucasian BMD; Hip axis length was significantly shorter	3
Cummings SR (75)	1994	Random sample of Caucasian women in SOF; black women from an ancillary study, and Asian women in an RCT for osteoporosis treatment	259	Measurement of Hip Axis length compared among the three groups; Comparison of BMD among the groups	Hip axis length significantly shorter in non-Caucasian women; Estimated that risk of fracture would decrease significantly (47% reduced in Asian and 32% decreased in Black women)	2
Carter DR (76)	1992	Technical paper describing new method of quantifying bone mass tested in health women age 17-40	75	Measurement of BMD compared to new test, Bone Mineral Apparent Density	Found BMD is moderately height dependent while Bone Mineral Apparent Density is height and weight independent	

Langlois JA (77)	2001	Longitudinal (22 years) cohort study (National Health and Nutrition Examination Survey (NHANES)) of community-dwelling white women 50-74 years old	2,180	To determine how weight loss from maximal weight affects risk of hip fracture	Weight loss of ≥ 10% was associated with increased fracture risk in older women, particularly in thinner women	2
Tromp AM (78)	2000	Longitudinal cohort study of healthy women ≥ age 70	348 16 hip fractures	Determine if BMD, biochemical markers of bone metabolism, age, BMI, mobility and previous fracture history predicted hip fracture	BMD (RR=6.1; 95% CI: 2.0-18.5), post-menopausal fracture history (RR= 3.5; 95% CI: 1.1-10.6) and age (RR= 1.1; 95% CI: 1.0-1.2) were associated with increased fracture risk	2
Tinetti ME (80)	1988	Prospective longitudinal cohort study of community-dwelling subjects ≥ 75 years	336	Determine incidence of falls and risk factors for falls through multivariate analysis	108 (32%) fell at least once; 24% of fallers sustained serious injury (6% fractured); Fracture risk increased with sedative use (OR = 28.3), cognitive impairment (OR = 5), lower extremity disability (OR =1.9); Fall risk increased with increasing number of risk factors	2
Tinetti ME (81)	1994	Prospective, longitudinal cohort study of representative sample of community-dwelling subjects ≥ 72 years	1103	Injuries associated with falls over a 2.5 year follow-up analyzed by regression models	546 (49%) experienced a fall; 183 fall-related injuries; Risk factors for falling were impaired cognition, increasing comorbidities, balance and gait impairment and low body mass index (BMI)	2
Alexander BH (82)	1992	Population-based retrospective administrative database of fall-related injuries in older adults In Washington State	149,504	Frequency of injuries and costs associated with treatment of injuries	Fall-related trauma accounted for 5% of all hospitalizations in 1989 and resulted in discharges to nursing homes more often than any other admission reason.	3
Stokes J (83)	1996	Retrospective review of Canadian administrative database of subjects ≥ age 65	Not stated	Determine cause of death and reasons for hospitalizations	Accidental falls were one of the leading causes of hospitalization and death in seniors	3

Kamel HK (84)	2000	Retrospective chart review of patients ≥ 65 years admitted with a hip fracture	170	Prescribing of Vitamin D, calcium or alendronate post hip fracture	Fewer than 10 patients received therapy while in hospital or as part of their discharge planning; Involvement of an internist did not increase prescribing of osteoporosis treatment	3
Jaglal SB (85)	1993	Population-based case-control study of women 55-84 years old from Toronto Canada (1990-1991)	2,519 381 cases 1,138 controls	Determine effects of past and current physical activity level on hip fracture risk	Previous moderate and high activity levels were protective for hip fracture independent of current activity level; Current moderate activity levels were also protective for hip fracture	2
Coupland C (86)	1993	Population-based case-control study of subjects ≥ 50 years from United Kingdom (1987-1988)	579 197 cases 382 controls	Determine effects of physical inactivity level on hip fracture risk	After adjustment for BMI, smoking, and dependence in ADL, physical inactivity doubled the risk of fracture compared to patients who were very active	2
Gregg, EW (87)	1998	Prospective cohort of non-black women ≥ 65 years in SOF followed for 7.6 years	9,704	Determine effects of physical activity level on hip fracture risk	Higher levels of leisure/sporting time and fewer hours of sitting/day decreased fracture risk; Very active compared to least active (RR = 0.64); Increased activity intensity reduced fracture risk.	2
Hoidrup S (88)	2001	Three population-based cohorts followed up for hip fracture in Copenhagen, Denmark	30,228 1,121 hip fractures	Determine the effect of leisure-time physical activity on hip fracture risk after adjusting for health behaviors and poor health	Being moderately active (2-4 hours/week) was protective for hip fracture (RR = 0.72 (95% CI: 0.59-0.89) and 0.75 (95% CI: 0.55,1.03) in women and men respectively. Being highly active did not add additional protection against fracture	2
Koval KJ (89)	1998	Prospective cohort of cognitively intact community-dwelling patients ≥ 65 years admitted with hip fracture	338	Determine which factors predict functional recovery at 3, 6, 12 months following hip fracture	16% of patients dependent prior to fracture; by 12 months, 73% returned to pre fracture BADL, but only 48% returned to pre fracture IADL; Age <85 and no comorbidities predictors for recovering BADL; Only decreasing age predicted IADL recovery	2

Dargent-Molina P (90)	1996	Prospective, longitudinal multi-centre (5 French regions) Epidémiologie de l'ostéoporose (EPIDOS) cohort study	7,575	Identify fall-related risk factors for hip fracture independent of BMD using multivariate analysis	After adjustment for BMD, slower walking speed, difficulty doing a heel-toe walk and decreased visual acuity remained risk factors associated with hip fracture	2
Nguyen TV (91)	1996	Prospective cohort study of men aged ≥ 60 years in Australia	820	Determine risk factors for osteoporotic fractures	In multivariate analysis, decreased quadriceps strength and increased body sway were independent risk factors for hip fracture	2
Ivers RQ (92)	2000	Case-Control study of subjects ≥ 60 years with and without hip fracture from New Zealand	1,821 911 cases 910 controls	Determine association between impaired vision and risk of hip fracture after controlling for age, sex, proxy response, physical activity and height	Having poor vision, no depth perception, not wearing glasses at time of fall and self-reported poor vision were all associated with increased fracture risk	3
Alem AM (93)	2000	Retrospective review of administrative data of renal patients	326,464 6,542 fractures	Determine if ESRD is associated with increased fracture risk	After controlling for age/gender, hip fracture was increased in men and women with ESRD compared to general population (OR= 4.4)	3
Coco M (94)	2000	Retrospective review of administrative data of renal patients	1,272 56 fractures	Determine if ESRD is associated with increased fracture risk	Standardized Fracture ratio of observed vs. expected fractures was 14.2 for men and 17.2 for women compared to the general population; Standardized Mortality for renal patients compared to general population increased following hip fracture (SMR = 2.4)	3
Cummings SR (95)	1998	Case-control study nested in a cohort of post-menopausal Caucasian women ≥ 65 years from SOF	9704 133 cases 343 controls	Determine the effects of serum hormone levels on risk of hip fracture	Women with low estrogen were more likely to fracture (RR = 2.5); Higher levels of sex hormone binding globulin increased risk (RR = 2.0); Having both low estrogen and high sex hormone increased risk (RR = 6.9)	2
Porter RW (96)	1990	Prospective, longitudinal study of institutionalized women > 69 years	1414	Determine association of ultrasound of the os calcis, cognition and mobility assessment and incidence of hip fracture over 2 years	73 women fractured during the study; Those with low cognition scores and low ultrasound os calcis readings were at higher risk	3

Marshall D (97)	1996	Meta-analysis of prospective cohort studies with BMD at baseline and subsequent follow-up for fracture (n = 11)	> 2,000	To determine prediction of fracture risk from osteoporosis	Measurements of BMD can predict fracture risk, but not.identify who will fracture; For one standard deviation (SD) drop in BMD below age-adjusted means (RR = 2.6) for hip fractures	2
Juby AG (98)	2002	Retrospective chart review of hip fracture patients > age 65 from Edmonton, Canada	311	Evaluate prevalence of diagnosis/treatment of osteoporosis following hip fracture	Osteoporosis diagnosed on admission in 11% of patients and in 15% at discharge. Treatment was instituted in 13% on at admission and 10% at discharge.	3
Hajcsar EE (99)	2000	Telephone survey with patients who sustained a fragility fracture	108	Assessment and treatment of osteoporosis following fragility fracture	Only 20 had a diagnosis of osteoporosis; 90% of these patients were taking calcium and Vitamin D; approximately 40% were on HRT and 40% on bisphosphonates; of the 88 non-diagnosed, 5% were on HRT and less than 20% were taking calcium and Vitamin D, none were on bisphosphonates	2
Leipzig RM (100)	1999	Meta-analysis of psychotropic medications and falls in older subjects (40 non-RCT)	29,167	Determine association between psychotropic drugs and falls	Small, but consistent association between psychotropic drugs and falls; increased falls occurred in patients taking more than one psychotropic medication	2
Leipzig RM (101)	1999	Meta-analysis of cardiac and analgesic medications and falls in older subjects (29 non-RCT)	79,809	Determine association between cardiac/analgesic drugs and falls	Digoxin, Type IA antiarrhythmic and diuretic use are associated weakly with falls. More than 3 medications increased fall risk.	2
Forsen L (102)	1994	Population-based prospective cohort study of adults 50 years and older in Norway with 3 year follow-up	34,856 421 fractures	Determine association between smoking and hip fracture risk; adjusting for BMI and physical inactivity	Using Cox-Regression adjusting for physical inactivity, RR for females (BMI= 25) who smoked was 1.5 compared to non-smokers; In thinner females (BMI =20); RR = 3.0; RR for males was 1.8 regardless of BMI	2

Kiel DP (103)	1992	Population-based cohort (Framingham study) of women	2,873	Incidence of fracture and relationship with smoking	No effect of smoking on hip fracture risk, but may negate the protective effect of HRT	2
Krall EA (104)	1991	Prospective cohort study of women with low to moderate calcium intakes (<600mg daily) between the ages of 40 and 70	320	Examined effect of smoking on BMD and bone loss rate over a two-year period	BMD of radius inversely proportional to pack years of smoking at baseline; Annualized rate of bone loss was greater in smokers.	2
Hopper JL (105)	1994	Cross-sectional study of monozygomatic twins who were discordant for at least 5 pack-years of smoking	82 41 pairs	Examined BMD between smoking and non-smoking twin	For every 10-pack-year of smoking, the BMD decreased by 2.0, 1.9 and 1.4 at the spine, femoral neck and shaft respectively. Women smoking one-pack daily through adulthood will have a 5-10% bone deficit at menopause, increasing fracture risk.	2
Orwell ES (106)	1996	Cross-sectional analysis of non-black women ≥ 65 years in SOF	7,963	Determine anthropometric, historical and lifestyle factors associated with BMD of spine and proximal femur using multivariate analysis	Predictors of higher BMD were post-menopausal estrogen use, diuretic use, increased activity levels, muscle strength, alcohol intake, and dietary calcium; Lower BMD was predicted by family history of osteoporotic fracture.	2
Holbrook TL (107)	1993	Prospective cohort of subjects ≥ 45 years from California	449	Determine effects of alcohol consumption on BMD of wrist, FN and lumber spine	Increased BMD was reported in both men and women who had moderate levels of alcohol intake, although differences were only significant in the radius,	3
Felson DT (108)	1995	Retrospective analysis of a longitudinal cohort of subjects 68-96 years old in the Framingham study followed prospectively for 18 years	1,154	Determine effects of alcohol consumption on BMD of wrist, FN and lumber spine	After adjustment for age, weight, height, smoking, age at menopause and estrogen use, women with increased alcohol intake had increased BMD; Men reported similar pattern to lesser degree.	2

Felson DT (109)	1988	Retrospective analysis of a prospective cohort of subjects (28-62 years old at entry into the Framingham study)	117, 224 person-yrs 217 hip fractures	Determine effects of alcohol consumption on hip fracture	In multivariate analysis, heavy current alcohol use was associated with increased fracture risk after adjustment for age (RR = 1.5 for women and 1.3 for men). Risk increased in subjects less than 65 years of age	2
Hernadez-Avila M (110)	1991	Prospective longitudinal cohort (Nurse's Health Study (NHS)) of women aged 34-59 years at study entry	84,484	Determine effects of caffeine, moderate alcohol intake on risk of hip and wrist fracture	Increased caffeine consumption (RR = 2.95) and increased alcohol consumption (RR = 2.33) increased risk of hip fracture with a dose-response relationship with alcohol	2
Farahmand BY (68)	2000	Population-based case-control study of post-menopausal women aged 50-81 years from Sweden with and without hip fracture using administrative and patient-reported data	4,589 1,327 cases 3,262 controls	Determine effects of socio-economic status and marital status on hip fracture risk	Employment (OR = 0.74), Socio-economics Status (OR = 0.74) and living in a single family dwelling (OR = 0.85) was protective; Divorced /widowed /single women had increased fracture risk compared to married/cohabiting women (OR = 1.4); Employed women living in a single family dwelling were at decreased risk (OR = 0.39) compared to single, unemployed women living in an apartment.	2
Ebrahaim S (111)	1995	Prospective cohort of middle-aged British men selected at random for the British Heart Study	7,735	Determine effect of marital status and change in marital status on mortality	After adjustment for age, smoking, social class, and comorbid conditions, never married and widowed men were at increased risk of non-cardiovascular mortality. Those who divorced during the 5-year follow-up were also at increased risk of mortality	2
Joung IMA (112)	1994	Prospective cohort study of Dutch men and women	18,973	To determine effect of living arrangement on self-reported morbidity (perceived general health, subjective health complaints, chronic conditions, work disability)	Subjects who lived with a partner had significantly lower self-reported morbidity after controlling for age, education and degree of urbanization	2

Kaprio J (113)	1996	Historical cohort study of Finnish men	1,162	To determine effect of marital status, social class and occupation on mortality	Executives had longest and unskilled workers the shortest life expectancy; Single men had significantly shorter life expectancy than married men	3
Norton R (114)	1999	Population-based case-control study of subjects ≥ 60 years with and without hip fracture from New Zealand	1,821 911 cases 910 controls	Examine the association between residential status and risk of hip fracture	After adjusting for age and gender, institutionalized subjects were at much higher risk of hip fracture (OR = 3.8); After adjusting for weight, comorbidities, cognition, previous falls and fractures, and Katz ADL rating risk remained higher (OR = 2.2)	2

Table 2.4 Determinants of Outcome

Primary Author (Ref #)	Date Published	Study Design	N	Purpose Of Study & Outcomes Evaluated	Findings	Level Of Evidence
Tidermark J (115)	2002	Prospective cohort study of healthy elderly 66-92 years old with a hip fracture compared to age-related norms	90	Determine HRQoL pre fracture, 1 week, 4 and up to 24 months after surgery using EuroQol (EQ-5D)	Similar baseline HRQoL to age-related norms (EQ-5D = 0.78 pre fracture); Still significantly lower at a mean time of 17 months postop (Eq-5D = 0.51); HRQoL was worse in patients with healing complications	2
Adachi JD (116)	2001	Cross-sectional survey of prevalent osteoporotic fractures (452) including hip fracture (78) in Canadian seniors	4,516	Determine HRQoL using the SF-36	Reduced HRQoL in patients with prevalent fractures; For women with hip fracture, HRQoL was particularly reduced in the physical functioning domain	3
Van Balen R (117)	2001	Prospective cohort of patients ≥ 65 years with hip fracture followed for the initial 4 months postop	102	Determine HRQoL, function and institutionalization following hip fracture	57% returned to previous living arrangement, 43% returned to previous functional level; HRQoL was lower than a reference population of similar age	3

Egol KA (118)	1997	Prospective cohort of community-dwelling, ambulatory subjects ≥ 65 years with a hip fracture	338	Determine predictors of functional recovery	Patients 85 years and older, living alone pre fracture with one or more comorbidities were slower or less likely to recover post fracture	3
Norton R (119)	2000	Case-control study comparing cases with hip fracture to age and sex-matched controls	1,328 572 cases 756 controls	Determining decline in physical functioning attributable to hip fracture in the first 2 years following fracture	After controlling for comorbidities, cases were 4.2 times more likely to be household ambulators, and 2.6 times more likely to be functionally dependent.	2
Myers AH (120)	1996	Retrospective chart review of a case series of community-dwelling elderly with hip fracture	100	Determine associations between pre fracture status, postop complications and mobility and location at discharge	Using multi-variate logistic regression, poor pre fracture health status was associated with reduced discharge mobility, pre-existing comorbidities led to increased complications developed	3
Jacobsen SJ (121)	1992	Retrospective review of US Medicare administrative data of subjects ≥65 years	712,027	Mortality in first two years following hip fracture	White women had lowest mortality followed by Black women, Black men and White men; Race/sex differences occurred at all ages	3
Dharmarajan TS (1)	2001	Retrospective observational study of patients > 60 years admitted with hip fracture	140	Comparison of ambulatory status immediately postoperatively between community and LTC residents	LTC residents were older with more risk factors for fracture; LTC has poorer pre fracture ambulatory status; both groups experienced decline in ambulatory status, but LTC more likely to experience major decline/	3
Magaziner J (2)	1990	Prospective cohort of community-dwelling subjects ≥65 years admitted with hip fracture	340	Determine effects of pre fracture health status on one-year walking, physical and instrumental functioning using multi-variate analysis	Increasing age, readmissions, decreasing cognition, depression in hospital in increasing LOS were associated with decreased recovery; At baseline vs. one year: independent 1) walkers (87% vs.53%), 2) Basic ADL (BADL) (70% vs. 40%), Instrumental ADL (IADL) (34% vs. 14%)	3

Koval KJ (122)	2000	Prospective cohort of community-dwelling, ambulatory, cognitively intact subjects ≥ 65 years admitted with a hip fracture	336	Determine ambulatory ability following hip fracture and risk factors associated with decreased post fracture ambulation	At one year, 40% returned to pre fracture ambulatory ability; 40% became dependent upon assistive devices; 12% became household ambulators; 8% became non-ambulatory; Decreased age, increased pre fracture ambulatory ability and IT fracture were all significant predictors of regaining pre fracture ambulation.	3
Nettleman MD (123)	1996	Retrospective review of Medicare administrative data of subjects admitted with hip fracture in Iowa	390	To identify determinants of 30-day mortality following hip fracture	Independent predictors of mortality were history of congestive heart failure (OR= 32.0), chronic obstructive pulmonary disease (OR = 11.0); Mortality reduced with postoperative aspirin use (OR = 0.24).	3
Dolan MM (3)	2000	Prospective cohort of community-dwelling subjects ≥ 65 years followed over a 2-year period following hip fracture	682	Examine short and long-term impact of delirium following hip fracture after adjusting for age, gender, race comorbidity and pre fracture function.	122 subjects without prior cognitive impairment were delirious on admission; Had decreased function and mobility, and increased depression 6 months post-fracture; No difference in mortality.	2
Hoenig H (124)	1997	Retrospective review of Medicare administrative data and chart reviews of subjects ≥65 years	1,880	To determine relationship of time to surgery and frequency of rehabilitation to institutionalization and 30-day and 6-mth mortality	Early surgical repair decreased LOS, but not associated with mortality; Increased PT/OT improved ambulation and return to community; Non-significant decrease in mortality.	3
Hamlet WP (125)	1997	Retrospective chart review and postoperative interview of patients with hip fracture at average follow-up time of 3 years	168	Determine relationship between preop health status and operative delay on mortality (Cox regression) and long-term ambulatory status	Overall mortality was 14% at one-year, 26% at 2-years and 33% at 3 years; Even in the healthiest sub-group, if surgery was delayed beyond 24 hours mortality increased (RR= 4.5); Independent post fracture ambulation independently associated with decreasing age, and independent living	3

Rodgers A (126)	2000	Meta-analysis of RCT's comparing anaesthetic technique in surgical patients (n = 141 studies)	9,559 2,617 orthopaedic	Determine effects of spinal vs. general anaesthetic on mortality and morbidity	Decreased mortality (OR – 0.7); DVT (OR = 0.56) and Pneumonia (OR= 0.61) decreased with spinal techniques	1
Zimmerman SI (4)	1999	Prospective cohort study of subjects ≥ 65 years admitted with hip fracture	308	Determine relationship with depression and one-year functional recovery	48% depressed in hospital; ½ resolved by 2 months; Depression at 2-months was significantly associated with poor one-year physical and instrumental functioning	2
Wolinsky FD (127)	1997	Prospective cohort study (LSOA) of subjects > age 70	7,527 368 hip fractures	Determine the independent effect of hip fracture on mortality, hospitalization and functional status	Hip fracture was significantly related to mortality (adjusted HR = 1.83) particularly in the first 6 post fracture months; Also significantly related to re-hospitalization (OR = 3.3) and decreased functional status.	2
Magaziner J (128)	2000	Prospective cohort of community-dwelling subjects ≥ 65 years admitted with a hip fracture	674	Describe changes in 8 areas of function in first 2 years after hip fracture	Recovery occurs first in depressive symptoms, cognition and upper extremity activities (approx 4 months) but lower extremity recovery takes up to one year	3
Marottoli RA (129)	1994	Prospective cohort of community-dwelling subjects ≥ 65 years who were part of the EPESE admitted with a hip fracture	2812 120 hip fractures	Determine risk factors associated with mortality and institutionalization at 6 months post fracture	22 (18%) died within 6 months; Mortality associated with increased number of comorbidities (OR = 9.8); FN rather than IT fracture (OR = 9.1); decreased mental status (OR = 6.9); increased complications (OR = 2.4). Institutionalization associated with poor baseline mental status (OR = 9.1).	2
Magaziner J (130)	2003	Longitudinal case-control study of community dwelling, ≥65 years Baltimore Hip Study cases and EPSESE control subjects	2,376 594 cases 1782 controls	Determine the difference in physical function attributable to hip fracture controlling for age, gender and comorbidities.	Cases were older, and more limited in ADL prior to fracture. After controlling for group differences, 50% of the cases and 21-29% of controls walked disabled (attributable disability was 26 additional cases/100)	2

Mutran EJ (131)	1995	Prospective cohort of community-dwelling Caucasian women $\geq$ 59 years admitted with a hip fracture	219	Determine the effect of social support and depression on physical recovery from hip fracture in the initial 6 months using risk-adjustment	Lack of social support and depression led to poorer walking ability at 2 months; At 6 months poor walking ability led to depression; Background factors were most important in 6 month recovery, but social support played large role in initial 2 months.	2
Hannan EL (132)	2001	Prospective cohort of subjects $\geq$ 50 years admitted with hip fracture followed to 6 months post fracture	571	Risk-adjusted in-hospital and 6-month mortality; 6 month ambulation	In-hospital and 6-month mortality was 1.6% and 13.5% respectively; Laboratory values were strong predictors of in-hospital mortality; Age and pre fracture residence were strong predictors of 6-month ambulation	2
Marottoli RA (133)	1992	Prospective cohort of community-dwelling urban subjects $\geq$ 65 years who were part of the EPESE study	2812 120 hip fractures	Determine the risk factors associated with change in physical function following hip fracture	85% at baseline vs. 49% at 6 months dressed independently; 90% vs. 32% transferred independently; 75% vs. 15% walked indoors independently; Pre fracture function and depression predicted 6-month function	3
Beloosesky Y (134)	2002	Prospective longitudinal cohort of hip fracture patients $\geq$65 years followed to 6 months post fracture	153	Risk-adjusted functional recovery using the FIM	Pre fracture FIM score was only significant predictor of post fracture function; Cognitively impaired improved as much as cognitively intact.	2
Stromberg L (135)	1997	Prospective cohort of community-dwelling urban subjects $\geq$ 65 years who were admitted with hip fracture; no control group	256	Examine cognitive status in hospital following a re-orientation program; Determine cognitive status effect on complications and service utilization	Cognitive functioning improved in hospital; Cognitively impaired patients had increased complication rate; Patients who developed acute delirium, but regained lucidity in hospital had same postoperative course as those without delirium	4
Milisen K (136)	1998	Descriptive prospective cohort of older subjects admitted with hip fracture	26	Describe cognitive decline; Determine the relationship between cognitive status and functional ability	Patients with severe cognitive impairment were older, more likely to be admitted from an institution and had more medical comorbidities; These patients also had the most functional limitation postoperatively	4

Goldstein FC (137)	1997	Prospective longitudinal cohort of hip fracture patients treated on an acute in-patient rehabilitation ward	58 35 impaired 23 not impaired	Compare function and discharge destination between subjects with and without cognitive impairment	Similar improvements in FIM during rehabilitation; Cognitively intact displayed greater gains in transfer ability; Similar discharge destination	3
Huusko TM (138)	2000	RCT of subjects ≥ 65 years admitted with hip fracture comparing intensive geriatric rehabilitation to usual care.	243 120 treat 123 controls	Determine mortality; LOS, functional recovery in a sub-group of patients with dementia	No difference in Mortality; LOS reduced in patients with mild dementia; Increased number of patients with mild and moderate dementia remained in community in the intervention group.	1
Kempen GIJM (139)	2003	Prospective cohort of community-dwelling urban subjects ≥ 57 years admitted with a fall-related injury	5,279 168 fall-related injuries	Examine effect of depressive symptoms on recovery of IADL following a fall-related injury	After risk-adjustment, baseline depressive symptoms did not predict recovery; Depressive symptoms at 8-weeks post injury significantly predicted functional recovery at 8 weeks, 5 and 12 months.	2
Cummings SR (140)	1988	Prospective cohort of subjects who were admitted with hip fracture followed out to six-months following fracture.	111	To determine if social supports influence functional recovery; Describe predictors of recovery	Patients who had greater social supports had more complete recovery even after risk adjustment, particularly patients older than age 60.	3
Salkeld G (9)	2000	Community-dwelling females ≥75 years who were eligible for an RCT of hip protectors to prevent hip fracture	194	To estimate the utility (preference) for health associated with hip fracture	On a scale of 0-1, a hip fracture that resulted in admission to nursing home was valued at 0.05. 80% of women would rather be dead than experience loss of independence and HRQL associated with fracture.	2
Randall AG (141)	2000	Prospective case-control study of hip fracture patients and age and sex-matched control subjects	61 32 cases 29 controls	Baseline evaluation of HRQoL using SF-36 and Osteoporosis Functional disability questionnaire occurred within one week, and again at 12-15 weeks following fracture	Hip fracture patients had poorer baseline and 3 month HRQoL compared to the controls, particularly in the physical and social domains.	2

Williams MA (143)	1994	Prospective cohort of community-dwelling women $\geq$ 60 years admitted with hip fracture	130	Determine physical and affective characteristics that lead to prolonged and short-term nursing home stay following hip fracture	Subjects with short-term nursing home stays did same as subjects discharged home, but had less social/caregiving support; Subjects requiring more care were older and more likely to experience complications; Increased affective disorders led to increased stays	3
Cumming RG (144)	1996	Case-control study with median follow-up of 14 months involving community-dwelling subjects $\geq$ 65 years with and without hip fracture	291 131 cases 160 controls	Determine risk of institutionalization following hip fracture	During follow-up, 26% of cases and 5% of controls were institutionalized (HR = 5.1After age and sex-adjustment; Further adjustment for comorbidities HR = 4.0)	2
Cree M (145)	2000	Prospective cohort of subjects $\geq$ 65 years admitted with hip fracture	558	Determine risk of mortality and institutionalization in first 3 months following hip fracture	Decreased cognitive status increased mortality and institutionalization; Males more likely to die (OR = 4.0); Increasing age increased risk of institutionalization; Low post fracture function increased institutionalization (OR = 5.0)	2
Leibson CL (146)	2002	Population-based retrospective case-control study using Mayo Clinic administrative database of cases with hip fracture and age and sex-matched controls	624 312 cases 312 controls	Determine change in disability, institutionalization and mortality at one month and one year	Cases significantly more likely to be institutionalized following fracture; Increased mortality in cases, particularly in those subjects residing in nursing home pre fracture; Increased disability post fracture in cases	3
Koval KJ (147)	1996	Prospective cohort of community-dwelling women $\geq$ 65 years admitted with hip fracture	516	Determine pre and post injury factors that were predictive of patients regainng pre fracture independent living status at 3,6 and 12 months post fracture	Patients younger than age 85, independent in ADL pre fracture, independent in ambulation at hospital discharge were more likely to regain independent living status	2

Coburn AF (148)	2003	Retrospective administrative discharge data of comparing subjects ≥ 65 years with hip fractures living in rural or urban areas	2,415	Compare outcomes and availability of services between rural and urban subjects	Rural patients more likely to be institutionalized than urban; Fewer services available.	3
Magaziner J (8)	1997	Prospective cohort of Caucasian community-dwelling women ≥70 years admitted with hip fracture compared to age-matched controls from LSOA	7,529 529 hip fractures	Compare 5 year mortality between groups controlling for education comorbidity, functional impairment and age using Cox regression	After risk-adjustment, mortality differential at 5 years post fracture was 9 deaths/100; those with increased comorbidity, excess mortality disappeared by 4 years; for healthiest group, excess mortality was still 4/100 at five years	2
Forsen L (149)	1999	Prospective Case-control study between 1986 until 1995 of subjects ≥ 50 years in Norway.	21,052 1,825 cases 19,227 controls	Determine excess mortality following hip fracture and see when it disappears controlling for age and sex using Cox Regression	Male hip fracture patients had increased mortality at one year regardless of age; Death for ages < 85 years old women (RR = 3.3) for men (RR = 4.2) in first year; ages 85 years and greater women (RR = 1.6) for men (RR = 3.1) in first year	2
Holmes J (150)	2000	Prospective cohort of subjects ≥ 65 years admitted with hip fracture	731	Risk-adjusted LOS and mortality in the initial 6 months following fracture	RR of mortality increased with dementia and delirium, but not with depression; LOS increased with presence of any mental disorder	2
Aharonoff GB (151)	1997	Prospective cohort of community-dwelling ambulatory subjects ≥ 65 years admitted with hip fracture	612	Determine risk factors associated with mortality at one-year following hip fracture using multi-variate analysis	Patient age >85, pre-injury functional dependence, development of ≥ one complication post-operatively	2
Chariyalertsak S (152)	2001	Retrospective review of administrative discharge data for subjects ≥ 50 years discharged following hip fracture from a province in Thailand; Cross-sectional assessment post fracture	330	Determine risk-adjusted mortality using Cox regression up to 2 years post fracture	3, 6 and 12-month mortality was 9, 12 and 17% respectively; Predictors of mortality were male sex, age > 80 years, presence of chronic illnesses, poor pre fracture walking ability and conservative management	2

Cauley JA (153)	2000	Prospective cohort of women between ages 55 and 81 who were in the Fracture Intervention Trial	6,459 907 fractures	Determine risk of mortality associated with clinical fractures after adjusting for comorbidities and health status	Patients with fractures were older, with lower BMD, and had a positive fracture history; 23 deaths were associated with a fracture; Increased age-adjusted death risk following fracture (RR = 2.2); Primarily related to hip (RR = 6.7) and vertebral fracture (RR= 8.6)	2
Myers AH (154)	1991	Retrospective review of administrative data for subjects ≥ 65 years with a hip fracture	27,370	Determine factors associated with mortality following hip fracture	Overall hospital mortality was 5%; Mortality doubled for each 5 year increment in age for Caucasian men and women; Relative odds (RO) of dying for: males (RO = 1.6); for septicemia (RO = 12.6), pneumonia (RO = 4.9) and digestive disorders (RO = 3.6); RO doubled in the presence of cardiac, neoplastic or cerebrovascular disease.	2
Meyer HE (155)	2000	Population-based case-control study of community-dwelling adults admitted with hip fracture and age/sex-matched controls followed for 3.5 years	496 248 cases 248 controls	Determine risk factors associated with mortality following fracture; Determine excess mortality due to hip fracture	After adjusting for poor cognition at baseline and presence of two or more chronic conditions, and decreased physical ability; there was no increased mortality in the hip fracture group; Subjects with at least one of these factors had increased mortality following hip fracture.	2
Koval KJ (156)	1999	Retrospective review of prospectively-gathered data on community-dwelling, ambulatory, cognitively intact subjects ≥ 65 years admitted with a hip fracture	495	Determine the effect of nutritional status on outcome following hip fracture adjusting for age, co-morbidity, gender and pre fracture mobility.	18% malnourished on admission based upon albumin levels, 57% based upon total lymphocyte count (TLC); Decreased albumin predictive of increased LOS and in-hospital mortality and decreased functional capacity; low TLC predictive of increased one-year mortality; Patients with low albumin and TLC were 2.9 times as likely to have increased LOS and 4.6 times more likely to not regain pre fracture ambulation level.	2

Gruson KI (157)	2002	Prospective cohort of community-dwelling ambulatory subjects ≥ 65 years admitted with hip fracture	395 180 anemic	Assess relationship between admission Hemoglobin and postoperative function, morbidity and mortality	Significantly increased risk-adjusted 6-month and one-year mortality and hospital LOS in anemic patients; No difference in in-hospital mortality, complications or postop function	2
Halm EA (158)	2003	Prospective, longitudinal, multi-centre cohort of subjects > age 50 admitted with hip fracture	559	Determine frequency and impact of clinical problems and new impairments on outcome following hip fracture	94 patients had active clinical issues at discharge; 229 had new impairments at discharge; Increased risk-adjusted mortality (OR = 1.8) and re-admissions (OR = 1.7); New impairments were associated with worse functional mobility	2
Lawrence VA (159)	2002	Retrospective administrative database review of patients ≥ 60 years admitted with hip fracture	8,930	Determine incidence of complications and outcomes associated with them following hip fracture	Cardiac and pulmonary complications were most common and associated with increased mortality; Patients with increased numbers of complications also had increased mortality; Most patients (81%) had no complications	3
Bernadini B (160)	1995	Prospective cohort of community-dwelling subjects ≥ 65 years admitted with hip fracture	97	Determine burden of comorbidity, identify clinical instability and functional recovery associated with comorbidity	Musculoskeletal and cardiovascular adverse effects were most common; Clinical instability, cognitive impairment and increasing age were associated with decreased rehabilitation potential and functional recovery	2

3. CAREMAPS IN THE HIP FRACTURE POPULATION

3.1. Background

Standardized treatment of patients based upon current evidence was recommended by the Royal College of Physicians in London in 1989, to encourage an integrated total care approach in the management of hip fractures.[32] Limited evidence indicates that caremaps utilizing an integrated approach may be an efficient means of treating patients with hip fractures.[15-19,185,186]

The purpose of clinical pathways or caremaps is twofold; firstly to standardize how care is delivered to this patient populations and the secondly to offer multidisciplinary care based upon the best current evidence.[187] Caremaps vary from focusing on specific nursing, rehabilitation or medical issues to coordinating all aspects of the patients' recovery process throughout the hospital stay.[20,188-191]

The majority of studies examining the effectiveness of standardized multi-disciplinary care in the management of orthopaedic conditions have involved small sample sizes, non-population based cohorts, and methodologically have lacked scientific rigor.[20] Studies have also been heterogeneous in terms of type and timing of interventions, and outcomes measured. Thus far, only mortality has consistently been shown to be unaltered by standardized multidisciplinary care.[20] No significant effects on the patient's functional recovery or health service utilization have yet been conclusively demonstrated with the administration of multi-disciplinary standardized medical care.

Moreover, studies examining effectiveness of implementing standardized protocols that provide evidence-based multidisciplinary care do not usually describe or measure how care differed as a result of the protocol. As usual care in this patient population is already multidisciplinary (physician/ nursing/rehabilitation at a minimum), the effect of adding further personnel and services is difficult to discern without careful evaluation of differences in processes of care. Before different outcomes can be expected, it must be established that delivery of care was altered by either the addition or improved application of existing services.

3.2. The Caremap Experience within Capital Health (CH)

As a large urban regional health authority, CH acts as the tertiary trauma referral centre for Edmonton and Northern Alberta, serving a catchment area of two million people. Following successful implementation of caremaps in the mid-1990's for total joint arthroplasty patients, orthopaedic clinicians began examination of the feasibility of a similar protocol for elderly hip fracture patients.

Development of the caremap was undertaken by a team representing multiple disciplines from the two sites treating patients with hip fractures. This team consisted of representatives from nursing, surgery, rehabilitation, gerontology, and dietary services. By examining the complications reported in this group as well as addressing available evidence, a caremap was developed for care occurring from time of hospital admission to time of discharge. Particular focus was placed on the management of delirium, bowel and bladder routines, the rehabilitative regime and discharge planning.

To ensure standardization of care, pre-printed orders were included with the caremap document. Orders were done for preoperative, perioperative and postoperative time frames. The caremap commenced use in March 1998 at both sites with the goals of reducing morbidity, improving functional recovery and, thus reducing LOS in the surgical hospitals.

Preoperative Care commenced at time of admission to the Emergency Department with standardized laboratory tests, and x-rays. Patients were also placed in Buck's traction, a practice that has since been proven to afford neither benefit nor harm to the patient.[192] A preoperative medical consultation was also ordered for all patients rather than at the discretion of the attending surgeon.

Patients were given high priority to get to the operating room as soon as medical clearance was obtained. The goal was to fixate the fracture surgically within 24 hours of admission because of the known adverse effects of delaying surgery.[124,125]

Once admitted to the ward, patients were assessed for risk of pressure sore development using the Braden scale, a commonly used pressure sore risk assessment tool. The Braden scale has good inter-rater reliability, specificity (70-91%) and sensitivity (40-100%) in various patient populations.[193,194] Pressure sores reduce quality of life and represent a major burden of illness and have a high associated cost for the medical system.[195] Within CH, all patients are nursed on preventative mattresses with alternating pressure mattresses available for those patients at high risk of pressure sore development as per the available evidence.[195]

Perioperative Care was defined as the time immediately prior to surgery to the first few days postoperatively through attainment of medical stability. Interventions during this phase included anaesthetic management, deep vein thromboses (DVT) and antibiotic prophylaxes and other general medical care (e.g. wound drainage, pain control, oxygen therapy and urinary tract and bowel management).

Surgical management was not included in the caremap because despite numerous clinical trials regarding specific surgical practices, best practice remains unclear in several areas.[30,31,34,37,38] For the most part, IT fractures received compression screw slide plate fixation, undisplaced FN fractures received three cannulated screws and displaced FN fractures received HA fixation.

Anaesthetic was recommended to be spinal wherever possible because of known adverse effects of general anaesthetic.[126] This practice was not under the direction of orthopaedic staff, but Anaesthesiology staff were made aware of the preference and supported this practice where possible. Suction wound drainage was implemented to promote wound healing following surgery by preventing large haematoma formation, although current evidence suggests there are no significant reductions in infection, wound healing, or mortality with the use of closed suction wound drains.[196]

DVT prophylaxis was given using heparin to reduce risk of DVT and pulmonary embolism as per available evidence.[197] Antibiotic prophylaxis has been shown to be effective in decreasing the incidence of postoperative superficial and/or deep wound infection, urinary tract infections and upper respiratory infections and was administered for 24 hours starting immediately preoperatively.[198]

Evidence is limited regarding appropriate pain control measures in this specific patient population. A delirium protocol was felt to be extremely important for these patients because of the high incidence of postoperative delirium. The Geriatrics service recommended avoiding the use of Meperidine (Demerol) to reduce delirium and Codeine to reduce delirium and adverse effects (i.e. constipation) associated with its use in elderly patients as per a published consensus document.[199]

The routine administration of oxygen via nasal cannulas for the first 48 hours postoperatively was used to maintain arterial oxygen saturation at or above 90%. Fugere et al. (1994) noted that maintaining oxygen saturation postoperatively reduced the incidence of myocardial ischaemia.[200]

Although evidence was lacking for bowel and bladder routines, nursing staff established standardized regimes for both of these areas of nursing care. Indwelling catheterization was recommended for all patients preoperatively because of their limited mobility. Because it was believed that prolonged periods of catheterization lead to bladder infection, a pre-written order was established to remove the catheter at day three following surgery where possible. Prior to caremap implementation laxative use was not standardized, and the patients were exposed to a wide variety of types and quantities of laxative to either prevent or treat constipation. Routine orders for type and quantity of laxatives were established as prophylaxis on the caremap with additional laxatives or increasing quantities allowed if patients developed constipation.

Dietary services recommended a high fibre, high calorie and high protein diet for this patient population because of the known association with malnutrition and in-hospital mortality. Although serum albumin was routinely collected on admission, Dietary services had inadequate staffing to perform a consultation with all patients who were considered malnourished prior to fracture. To offset the staff shortage, all patients were given this diet regardless of nutritional status to ensure that malnourished patients received adequate nutrition while in hospital.

Postoperative care started following medical stabilization with the focus of treatment moving to mobilization and rehabilitation. Early mobilization was a hallmark of rehabilitation treatment of the post-surgical elderly patient despite the lack of formal evidence of its benefit. Patients were sitting on the edge of the bed or in a chair the first postoperative day. Ambulation started on day two postoperatively in patients who were ambulatory prior to fracture and who did not have significant cognitive impairment. Altered cognition was not exclusion for rehabilitation, but patients had to be reasonably cooperative with rehabilitation staff. Goals of rehabilitation were getting the patient to the highest level of independence possible in transfers, and ambulating for increasing distances on flat ground.

In addition to starting mobilization when patients were deemed medically stable, discharge and continuing rehabilitation planning also commenced. Because a significant proportion of patients were referred from outside of the health region, objectives regarding timing of transferring back to their local health region were also contained within the caremap. Caremap goals for these patients were medical stability followed by transfer to their local hospital, usually within three days following surgery. Admissions from nursing homes within the CH were also treated with this modified mobilization routine because of concerns regarding the patient losing their bed within the residential institution. Although all patient groups received early mobilization, rehabilitation goals were much more modest in the transfer group than with the community-dwelling in-region patients.

The caremap involved standardizing care during the initial postoperative period when the patient remained in the surgical hospital. The caremap did not extend to sub-acute rehabilitation facilities, home care or institutional settings. Coordinated discharge planning was incorporated to try to improve communication across settings and provide a more seamless care continuum for the patients, but the focus of the caremap was from time of admission to hospital to the initial seven to ten days postoperatively in the surgical hospital.

3.3. Summary

Standardized care in the hip fracture populations as a strategy to decrease morbidity, augment the pace of postoperative recovery and, thus reduce LOS in hospital has been the goal of several medical centres both within Canada and internationally.[18,19,190,191] These centres have reported mixed outcomes in their results. Although adverse effects have not been reported, neither have there been significant benefits. Most studies have not reported how service delivery differed as a result of their intervention. Further, most studies excluded patients residing in institutions or with cognitive impairment; thus excluding patients who would be most likely to experience increased morbidity post fracture because of their frail pre fracture health. Finally, many of the studies have only looked at the effects of the caremap on the initial postoperative recovery without examining how initial pre and postoperative care affects recovery in the sub-acute phase and out to six months following fracture.

Table 3.1 Evidence-based Treatment of Hip Fracture Patients

Primary Author (Ref #)	Date Published	Study Design	N	Purpose Of Study & Outcomes Evaluated	Findings	Level Of Evidence
Kennie DC (15)	1988	RCT of multi-disciplinary vs. routine orthopaedic care following admission for hip fracture	108 54 treat 54 controls	Determine mortality, LOS, functional status, place of residence, carer-burden one-year after fracture	LOS significantly decreased (56 vs. 37 days); Increased function in control; No difference in other outcomes	1
Zuckerman JD (16)	1992	Cohort study with historical controls compared to intervention group of ambulatory subjects ≥ 65 years with a hip fracture	491 431 treat 60 controls	Determine mortality, LOS, functional status, place of residence at discharge from hospital without risk adjustment	Decreased postop complications, LOS and improved discharge function; No change in discharge destination or mortality	2
Ogilvie-Harris JD (17)	1993	Two prospective cohorts of elderly subjects admitted with hip fracture compared before and after caremap implementation	106 55 treat 51 controls	Determine effect of caremap implementation on morbidity, function, LOS and mortality	Reduced LOS, morbidity and improved early function; no change in mortality	2
Galvard H (185)	1995	RCT of geriatric rehab vs. routine orthopaedic rehab following hip fracture	371 192 treat 175 controls	Determine mortality, place of residence, one-year after fracture	Increased LOS in geriatric rehab; Increased re-admissions in orthopaedic group	1
Choong FM (186)	2000	Pseudo-RCT of patients admitted with hip fracture treated with either standard care or clinical pathway	111 55 treat 56 controls	Timing of referrals and discharge planning; LOS; complication and re-admission rates	Decreased LOS in pathway group; No other differences.	2
Huusko TM (18)	2002	RCT of subjects' ≥ 65 years admitted with hip fracture comparing intensive geriatric rehabilitation to usual care.	243 120 treat 123 controls	Mortality; LOS, functional recovery	No change in Mortality; median LOS reduced to 34 from 42; IADL recovered faster in the intensive rehabilitation group	1
Naglie G (19)	2002	RCT of patients admitted with hip fracture treated with either standard care or clinical pathway emphasizing early mobilization	279 138 treat 141 controls	Mortality, Function, and Discharge location	Non-significantly decreased 6-month mortality; Increased LOS in Treatment group; Cognitively impaired patients most improved by program	1

March LM (187)	1999	Meta-analysis of evidence-based treatment for hip fracture patients (N=11 studies with Level I and II evidence)	Not Stated	Examined medical therapies for treatment of hip fracture patients	Developed evidence-based acute care pathway for elderly patients with hip fracture	2
Cameron ID (20)	2001	CSR of RCT's examining effectiveness of multi-disciplinary inpatient rehabilitation of subjects $\geq$ 65 years with hip fracture (n= 9 trials)	1869	Mortality, LOS, Functional recovery, Institutionalization and Morbidity	No difference in mortality or institutionalization; 2/5 studies showed improvement in functional recovery; Studies very heterogeneous and difficult to compare	1
Cameron ID (188)	1994	RCT comparing cost-effectiveness of accelerated rehabilitation to usual care and rehabilitation in elderly subjects with hip fracture	252 126 treat 126 controls	Costs; LOS; Functional recovery	Decreased LOS in intervention, but increased re-admissions; Total cost non-significantly lower in treatment group	1
Parker MJ (189)	2001	CSR of RCT's examining mobilization strategies for subjects $\geq$ 65 years with hip fracture (n= 5 trials)	517	Morbidity; mortality, functional recovery and institutionalization	Very heterogeneous approaches; No significant differences in outcomes	1
Swanson CE (190)	1998	RCT of patients admitted with hip fracture treated with either standard care or clinical pathway emphasizing early mobilization	71 38 treat 33 controls	Function, LOS, Mortality	Decreased LOS in treatment group; Significantly improved function at discharge; No difference in mortality	1
March LM (191)	2000	Cohort study with historical control group compared to intervention group (clinical pathway) of subjects $\geq$ 65 years admitted with a hip fracture	936 481 treat 455 controls	LOS, Mortality, Morbidity, Institutionalization	No change in 4-month mortality or institutionalization; LOS non-significantly reduced	2
Parker MJ (192)	2002	CSR of RCT's comparing use of preoperative traction in elderly patients with hip fracture (n= 6 trials)	1038	Analgesic use; pain. Ease of fracture reduction; complications	No benefit for use of traction; Trend toward harm with increase in complications with use of traction	1

Barnes D (193)	1993	Prospective cohort study of patients > age 65 admitted to acute care hospital	361	Determine sensitivity and specificity of Braden Scale in predicting pressure sore development	Sensitivity = 73% Specificity = 91%	2
Bergstrom N (194)	1992	Prospective cohort study of patients > age 65 admitted to nursing home	200	Determine risk factors associated with pressure sore development	Predictors of developing pressure sores were increasing age and Braden scale score; Decreased diastolic blood pressure, dietary protein and body temperature	2
Nuffield Institute of Health (195)	1995	Systematic review of assessment and treatment strategies for prevention of pressure ulcers (n = 30 studies)	Not applicable	Determine effectiveness of pressure sore development risk assessment and preventative strategies	Patients at increased and very increased risk should be nursed on foam and alternating pressure mattresses respectively.	2
Parker MJ (196)	2002	CSR of RCT's comparing use of closed suction wound drainage in orthopaedic patients (n= 21 trials- 3 hip fracture studies)	2,772	Determine wound healing, dehiscence; Reoperation, Dressing changes, Transfusion, Infection and thrombo-embolic events	No difference in infection, wound issues; Increased transfusion in drain group; Increased dressing changes in control group	1
Handoll HH (197)	2000	CSR of RCT's comparing DVT prophylaxis in hip fracture patients (n= 26 trials)	2,600	Examine effects of various methods of preventing DVT and pulmonary embolus postop	Decreased DVT with any form of heparin, mechanical compression device; no change in PE; Unable to differentiate between heparin types	1
Gillespie WJ (198)	2002	CSR of RCT's comparing antibiotic prophylaxis in hip and long bone fractures (n= 22 trials)	8,307	Determine if antibiotics reduces incidence of wound or hospital-acquired infections	Decreased infection with use of prophylaxis; Single dose is adequate if effect is for at least 12 hours.	1
Beers MH (199)	1997	Consensus statement regarding use of inappropriate medications for elderly patients	Not applicable	Consensus of expert panel regarding validity of criteria for medication use.	Meperidine should be avoided in the elderly.	3
Fugere F (200)	1994	RCT comparing supplemental oxygen in the first 24 or 72 hours or no supplemental oxygen (O2)	83	Determine incidence of hypoxemia, myocardial ischaemia	Hypoxemia common in first 24 hours with no oxygen supplementation; Myocardial ischaemia reduced with 24 hour use of oxygen.	1

4. METHODS

4.1. Part one

4.1.1. Primary Objectives

The primary objectives of this study were to determine how implementation of a caremap as standardized treatment for elderly patients affected:

a) Risk-adjusted functional recovery
b) Risk-adjusted HRQoL
c) Risk-adjusted institutionalization

during the initial six months following hip fracture. These objectives were met through comparison of two population-based cohorts of patients who agreed to participate in the follow-up study. The Control group was enrolled prior to caremap implementation and the Caremap group was enrolled after implementation of standardized treatment.

4.1.2. Hypotheses

Utilization of a hip fracture caremap will standardize care of patients with hip fracture resulting in:

1) Improved functional recovery
2) Improved HRQoL
3) Reduced institutionalization rate

in the initial 6 months following fracture in the Caremap group in comparison to the Control group.

4.1.3. Design

This study was a comparison of two independent population-based prospective cohorts. Prospective data were collected from a consecutive cohort of 451 patients who were treated using the caremap of the CH region between July 1999 and October 2000. Prospective data collected from 468 patients who had hip fractures treated in the CH between July 1996 and September 1997 served as the control group as they were treated prior to caremap implementation.[145]

Although a RCT is the most rigorous study design, several factors led to the decision to use a pre/post design. Firstly, the pre-caremap cohort was assembled for another study that examined the rate of institutionalization and mortality among patients with hip fractures in the CH. Because extensive data were gathered on a population cohort just prior to implementation of the caremap, it provided a unique opportunity for a pre/post study design. Moreover, this study group was a population-based cohort whose treatment reflected then current practice patterns within the health region.

Secondly, a shortage of available beds in both surgical hospitals removed the possibility of having intervention and control treatment units within each hospital. Moreover, if the patient had been used as the unit of randomization, Caremap and Control subjects could have been in the same room being treated by the same staff with the risk of significant contamination of the intervention.

Finally, CH is a teaching region with medical residents working out of both hospitals in which hip fractures are managed in CH. If the hospitals had been used as the unit of randomization, staff would have been crossing over between intervention and control sites, risking contamination of the intervention, and therefore dilution of treatment effects. In addition, co-intervention effects may have occurred.

Therefore, the decision was made to use the pre-caremap cohort as the Control group. To assess potential sources of bias, which could present a serious threat to the internal validity of the study, assessment was undertaken to determine whether service changes other than caremap implementation had occurred between the two study time periods. We do not think this occurred to a significant extent for the reasons listed below.

First, there was continuity of the site of care as patients in both cohorts were treated in the same hospitals, and there were no changes to bed allocated for orthopaedic patients in either hospital. No major funding changes occurrd on the orthopaedic service that affected non-elective surgeries such as hip fracture. Second, despite the three-year time period between the two cohorts, other than the implementation of the caremap, there had been minimal changes to service delivery in rehabilitative and home care services. Finally, outside of the hospital setting, there was also no change between study time periods in terms of resources added, either health care personnel or long-term care beds.

4.1.4. Selection Criteria

All patients aged 65 years and over admitted to the aforementioned institutions in Edmonton with a hip fracture, who lived within local calling distance of Edmonton during the two study intervals were eligible for enrolment in the study (See Appendix 9.2). The extended flat rate calling for telephone service did not change over the two study horizons.

The following patients were excluded from both groups:

1) Patients with a pathological fracture arising from an underlying bone disease other than osteoporosis such as primary or secondary tumor, or Paget's disease

2) Patients who re-fractured their hip within the past five years or who were readmitted for further treatment of a previous fracture

3) Patients who were already in the study, (i.e. patients who were enrolled in the Control cohort were not enrolled in the Caremap cohort). Additionally, patients who fractured their other hip within the six months of their initial fracture were also not enrolled a second time.

4) Patients who did not speak English nor had available proxies who spoke English

5) Patients without a telephone or available proxy with a telephone.

Demographic information was collected on eligible patients who did not participate in the study, so any systematic differences between respondents and non-respondents could be identified. The University of Alberta and CH Joint Research Ethics Panel A granted ethics approval for this portion of the study.

4.1.5. Method

In both cohorts, a trained research assistant identified appropriate subjects through review of admission records to the Orthopaedic service. These candidates were approached for enrolment into the follow-up cohort within four to six days of admission to the surgical hospital, which was generally following surgical fixation of their hip fracture. Written informed consent was obtained from the patient prior to the baseline interviews (See Appendix 9.3). For those patients with cognitive impairment (MMSE scores less than 22/30) or who did not speak English, proxy respondents were identified and asked to respond to the questionnaires on their behalf.

At the baseline interview, patients were asked to recall health status, functional status and social support immediately prior to the fracture as well as to report functional status four to six days postoperatively. Some of the collected information was subject to recall and/or ascertainment bias given that the data were collected after the occurrence of the hip fracture. As this is the information that would normally be available at the time of hospitalization in most trauma situations, these results are applicable in clinical settings.

Participants were followed for six months after the occurrence of the hip fracture. Trained research assistants conducted telephone interviews at three and six months post fracture, which included the assessment of overall health status with the same instruments used at the baseline interview. Patients were interviewed directly if their cognitive status was adequate, and if inadequate, information was obtained from a proxy as previously indicated. Interviewees were also asked if there had been any 1) complications requiring medical intervention, 2) hospitalizations and 3) changes in residential status.

All data were entered into an ACCESS database specifically programmed for the study. The database was programmed to mirror the data collection forms to minimize data entry errors. In addition, validation rules were set with patient identification numbers, and the range of possible values to enter for each question, to further reduce errors. Missing values were set to "-99" so that all data fields were completed. The Control cohort data were re-entered into this database to ensure that all data fields would match between cohorts. Only two individuals were responsible for entering all data for the both cohorts. The data manager also did routine checks of the data to monitor and correct any errors, and to ensure that all subjects were entered into the database.

4.1.6. Measurements

The following instruments were used at the baseline interviews in both cohorts - 1) MMSE, 2) Modified BFI, 3) Rand-12 HSI, 4) TyPE Specific hip fracture questionnaire, and 5) OARS social resources scale. Interviewers were trained in administration of the interviews to ensure standardization in both the Control and Caremap cohorts. At the beginning of the study, meetings were held with the previous team of data collectors to ensure interviews were conducted in a similar way with both cohorts. To improve reliability among interviewers, bimonthly staff meetings were held to ensure all interviewers were managing patient responses in a similar fashion. Further, the data collection forms were identical between cohorts (See Appendix 9.3).

4.1.7. Outcomes

The following outcomes were assessed:

1) Function at five to seven days postoperatively as well as at three and six months post fracture utilizing the BFI. Descriptive statistics were performed on measurements obtained at each evaluation period. Three-month post fracture function was chosen for building risk-adjusted models because the majority of functional recovery had occurred by that time.
2) HRQoL at three and six months utilizing the RAND-12 HSI as well as the change between the baseline and three-month scores. Modelling was again performed on the three-month scores because the majority of change in HRQoL had occurred by that evaluation period.

3) Institutionalization at 6 months as obtained through the follow-up interviews. Institutionalization was evaluated only at the end of the assessment period to determine the institutionalization rate in the first six months post fracture.

4.1.8. Sample Size Calculations

Both groups were large population-based cohorts, with more than adequate numbers to be able to discern clinically important differences in all primary outcomes. For example, to be able to detect a five-point difference (the minimal clinically important difference) between groups in the the mean BFI score, with a standard deviation of 21 points (the baseline standard deviation in the BFI), 277 patients would be required per group. Further, 199 patients per group would allow detection of a change from 20% (current rate reported in the literature) to 10%, in the rate of institutionalization.

4.1.9. Data Cleaning

Prior to the analysis, data were extracted to an EXCEL spreadsheet and examined for any inconsistencies. Any missing data obtainable from the chart review were added at this point (i.e. missing birth dates, gender). Missing data were recoded to "missing value" and text fields were changed to numeric fields where appropriate prior to importing the data into the Statistical Package for the Social Sciences (SPSS) version 11.5.2 for analyses. Errors in data entry were checked through examination of frequencies for discrete variables and obtaining descriptive statistics for continuous data.

4.1.10. Data Analysis

4.1.10.1. Demographics

Univariate and bivariate analyses were performed for descriptive purposes. Baseline characteristics (i.e. age, sex, comorbidities and cognitive status) were compared using standard statistical techniques (t-tests for continuous variables and χ^2 tests for categorical variables) to identify any initial systematic differences between cohorts.

4.1.10.2. Non-Respondents

Patients who refused or were unable to consent to study participation were compared to participants in the follow-up cohorts using standard statistical techniques (t-tests and χ^2 tests) to identify any systematic differences. Non-respondents in each of the follow-up cohorts were also compared to each other to identify any differences in non-participants between cohorts.

4.1.10.3. Losses to Follow-up

Patients who agreed to participate in the follow-up study, but who were lost to follow-up prior to the end of the six-month follow-up period were compared to those completing the study. Comparisons were made in baseline characteristics and postoperative course to determine whether losses occurred randomly or had a systematic component. Demographic characteristics of those subjects remaining in the study at six-months were also analyzed to ensure the remaining respondents were similar in baseline characteristics.

4.1.10.4. Patient versus Proxy Respondents

Comparisons were also made between the two cohorts using χ^2 tests to determine proportions of patient and proxy respondents in each cohort.

4.1.10.5. Primary Objectives

Descriptive statistics of Functional Recovery were initially undertaken to examine the mean and standard deviation of scores achieved at each of the evaluation points. Independent t-tests were used to determine if the groups were significantly different at any of the evaluations. Comparisons using χ^2 tests were also made between the cohorts of the proportion of subjects who returned to their pre fracture functional level by three and six months following hip fracture. Finally, comparisons of functional recovery, in patients with and without dementia, were undertaken using repeated measures analysis of variance (ANOVA) to determine if these two sub-groups of patients differed in their recovery between the two cohorts.

Risk Adjusted Functional Recovery was analyzed using ordinary least squares (OLS) linear regression analysis, with the three-month BFI score as the dependent variable. The three-month follow-up was chosen for risk adjustment because the majority of postoperative improvement had occurred by that evaluation.

Bivariate analysis was undertaken with each cohort separately to examine if there were different relationships with the clinical variables and three-month BFI scores between cohorts. Following the bivariate analysis, trivariate analysis was undertaken.

Trivariate analysis was undertaken using analysis of covariance (ANCOVA) with those variables that were significant in either bivariate analysis at $p \leq 0.20$ or were deemed clinically important variables. Thus, each of the trivariate models included the clinical predictor variable of interest, the dependent variable (three-month BFI variable) and the group variable (Caremap versus Control). In addition to the main effects, interactions between the variables chosen and group were also examined prior to the multivariate analysis. This secondary step in the preliminary analysis allowed further elucidation of the effect of the caremap on the dependent variable, as it was this relationship that was of primary significance in the analysis.

Multivariate analysis was undertaken as the final step in the model building process. Model building was done based upon purposeful selection of clinically important variables as well as those variables significant at $p \leq 0.20$ or less in the bivariate or trivariate analyses. As interaction was seen between the group variable and a measure of social support, the parallelism assumption for ANCOVA was not met. Thus, OLS linear regression was used for the final multivariate model, so that the interaction effect could be retained in the model.

Continuous variables (i.e. age) were tested for linearity by plotting the mid-point of categories reflecting quartile measurements of the variable. Categorical variables were entered in as "dummy" variables when there were non-linear relationships between categories and the dependent variable.

The following variables were considered as possible clinically important predictors of the three-month BFI score:

- ☐ *Group* – Caremap versus Control
- ☐ *Demographic variables* – Age, Sex, Admission from lodge or institution versus community

- *Medical Variables* – Charlson Comorbidity Index Score, complications, cognition, comorbidities, fracture type (i.e. FN, IT or ST)
- *Functional Variables* – Pre fracture BFI score, Pre-fracture ambulation
- *Social Support Variables*- Marital status, Social support (measured as: 1) someone available to assist them if they were ill and 2) weekly telephone contact).

Following construction of the final multivariate model, the amount of variance in the dependent variable explained by the chosen independent variables (R^2) was reported.

Descriptive statistics of PHC and MHC scores were initially undertaken to examine the mean and standard deviation of scores achieved at each of the evaluation points in the two cohorts, and to determine if these scores differed between cohorts. The rate of change between the baseline and three-month scores, which was the postoperative timeframe in which most of the improvement occurred, was also performed. Two new variables were calculated by subtracting the baseline scores from the three-month scores, dividing by the baseline scores and finally, multiplying by 100 for both the PHC and MHC score, to reflect the percentage change occurring during that time interval.

Risk-adjusted HRQoL was analyzed for physical and mental health using OLS linear regression analysis and ANCOVA, with the three-month PHC and MHC scores as the dependent variables respectively. Three-month scores were, again, chosen because this interval reflected the time period when majority of recovery in HRQoL occurred.

Bivariate analysis was undertaken with each cohort separately to examine if there were different relationships with the clinical variables and HRQoL at three months post fracture between the cohorts. The clinically important variables and those variables significant at $p \leq 0.20$ from both bivariate analyses (Control and Caremap cohorts) were then tested in a trivariate analysis with group using ANCOVA, as previously described. Both main effects and interactions with each variable and group were examined in the trivariate analysis prior to the multivariate analysis.

Multivariate analysis was undertaken as the final step in the model building process. Model building was done in the same fashion as that undertaken for functional recovery. Variables were selected based upon either their clinical importance or their significance ($p \leq 0.20$) in the bivariate analyses.

Continuous variables (i.e. age) were tested for linearity by plotting the mid-point of categories reflecting quartile measurements of the variable. Categorical variables were entered in as "dummy" variables where there were non-linear relationships between categories and the dependent variable.

The following variables were considered as possible clinically important predictors of three-month PHC and MHC scores:

- ☐ *Group* – Caremap versus Control
- ☐ *Demographic variables* – Age, Sex, Admission from lodge or institution versus community
- ☐ *Medical Variables* – Charlson Comorbidity Index Score, complications, cognition, comorbidities, fracture type
- ☐ *Functional Variables* – Pre fracture BFI score, Pre-fracture ambulation
- ☐ *HRQoL variables* – Pre fracture MHC and PHC
- ☐ *Social Support Variables*- Marital status, Social support.

Following construction of the final multivariate model, the amount of variance in the dependent variable explained by the chosen independent variables (R^2) was reported.

Descriptive analysis of institutionalization was undertaken to determine whether the proportion of patients who were institutionalized by six months following hip fracture in each of the cohorts was significantly different as analyzed using χ^2 tests. Institutionalization was defined as requiring nursing home care. Subjects who moved from the community to a senior's residence or lodge were not considered institutionalized. Only those patients in the follow-up cohorts who were admitted from the community were included in this analysis. Those patients who were already institutionalized at the time of fracture were not considered.

Risk Adjusted Institutionalization was analyzed using unconditional logistic regression with institutionalized (Yes/No) at six-months as the dependent variable.

Bivariate analysis was undertaken with each cohort separately to determine if predictors of institutionalization differed between the two groups. Model building was done using purposeful selection of variables as previously described. Those variables that were significant at $p \leq 0.20$, as well as those considered clinically important were tested in a trivariate analysis with group to determine the relationship with the study intervention, as previously described. Both main effects and interactions were assessed in the trivariate model.

Multivariate logistic regression analysis was then undertaken using the clinically important and statistically significant determinants from the preliminary analyses. The following variables were considered as possible clinically important predictors of institutionalization:

- ☐ *Group* – Caremap versus Control
- ☐ *Demographic variables* – Age, Sex, admission from lodge versus home

☐ *Medical Variables* – Charlson Comorbidity Index Score, number and type of complications, cognition, number/type of comorbidities, fracture type

☐ *Functional Variables* – Pre fracture BFI score, Pre fracture ambulation, Three-month BFI, Three-month ambulation, Three-month pain

☐ *Social Support Variables-* Marital status, Social support.

Following construction of the final multivariate model, the Hosmer and Lemeshow Goodness of Fit test was used to determine whether the model's observed values were different than the values predicted, with a significant test indicating a poor fit of the model.

4.2. Part Two

4.2.1. Secondary & Tertiary Objectives

Secondary objectives of the study were to evaluate whether, for all eligible patients who sustained a hip fracture during the two study periods, the caremap:

a) Reduced in-hospital morbidity
b) Reduced risk-adjusted in-hospital mortality
c) Reduced LOS in the surgical hospital
d) Increased the discharge of patients directly home
e) Reduced re-admissions to hospital in the initial six-months.

Tertiary objectives of the study were to examine how service delivery differed as a result of the caremap being put into place. Service delivery differencess were assessed through comparison of the two cohorts in:

a) Medication protocols
  ☐ Narcotics
  ☐ Laxatives
  ☐ Anticoagulants
b) Timing of Interventions
  ☐ Surgical fixation of the fracture
  ☐ Commencement of postoperative rehabilitation
  ☐ Time with indwelling catheter

4.2.2. Hypotheses

Standardized care will result in:

1) Reduced in-hospital morbidity
2) Reduced in-hospital mortality
3) Reduced LOS in the surgical hospital

4) Increased discharges directly home rather than for further rehabilitation
5) Reduced readmissions in the initial six-month post fracture period

in the Caremap group compared to the Control group.

Measurements of standardized care will demonstrate:

1) Reduction in types of narcotics and laxatives used
2) Increased anticoagulant use
3) Reduction in time to surgical fixation
4) Reduction in time to first postoperative rehabilitation intervention
5) Reduction in time with indwelling catheter in situ

in the Caremap cohort compared to the Control cohort.

4.2.3. Design

This portion of the study was a comparison of data retrieved through chart reviews of two independent population based prospective cohorts. Data were collected from a consecutive cohort of 663 patients who were treated using the caremap of the CH between July 1999 and October 2000. Data collected from 678 patients who had hip fractures treated in the CH between July 1996 and September 1997 served as the Control group as they were treated prior to caremap implementation. These patient groups include the subjects described in Section 4.1.3 (interviewed patients) as those who refused to be interviewed and were therefore excluded from the previous analysis. Ethics approval was also obtained for this portion of the trial from the University of Alberta and CH Joint Research Ethics Panel A.

4.2.4. Selection Criteria

All patients aged 65 years and over admitted to the aforementioned institutions in Edmonton with a hip fracture as diagnosed using the International Classification of

Diseases, 9th Revision, Clinical Modification codes 820.0 to 820.9, primary diagnosis or any diagnosis, who lived within local calling distance of Edmonton during the two study intervals were included in the comparison of secondary and tertiary objectives.

4.2.5. Measurements

Baseline information on demographic variables, comorbidities, and residential status prior to the hip fracture were gathered. Further data were also collected regarding type of fracture, type of surgical fixation, in-hospital complications including admissions to the Intensive Care Unit (ICU) and in-hospital mortality. Patients who sustained a contralateral hip fracture within six months of their initial fracture had the second fracture counted as a complication.

Data were also obtained on the following service delivery variables: 1) time to surgical fixation from hospital admission, 2) time with indwelling catheter, 2) time to initial postoperative rehabilitation, 3) type and quantity of medications utilized (e.g. narcotics and laxatives) to compare differences in medical care between the two cohorts.

Finally, LOS in the surgical hospital and discharge location were also obtained through the chart review while re-admissions to any facility during the six-month study period were captured through regional databases.

Chart reviewers from the Control cohort trained the two chart reviewers for the Caremap cohort to reduce the incidence of systematic errors. Chart reviews were checked on a random basis to ensure data collection was complete and accurate. Reviewers were instructed to bring any difficult charts to the attention of the research coordinator. Those charts were subsequently reviewed with the assistance of the coordinator. All data were entered into the ACCESS database previously described in section 4.1.5.

4.2.6. Data Cleaning

Prior to the analysis, data were extracted to an EXCEL spreadsheet and examined for any inconsistencies. Chart reviews with consistent data were rechecked and corrected. Missing data were recoded at this point and text fields were changed to numeric fields where appropriate prior to importing the data into the SPSS version 11.5.2 for analyses. Errors in data entry were checked through examination of frequencies for discrete variables and obtaining descriptive statistics for continuous data.

4.2.7. Data Analysis

4.2.7.1. Demographics

Univariate and bivariate analyses were performed for descriptive purposes of all patients involved in this portion of the study. Baseline characteristics (i.e. age, sex, comorbidities and cognitive status) were compared using standard statistical techniques (*t*-tests for continuous variables and χ^2 tests for categorical variables) to identify any initial systematic differences between cohorts.

4.2.7.2. Secondary Objectives

In-Hospital Morbidity was analyzed through measurement of type and number of complications while in hospital using χ^2 tests. Admission to the ICU was also considered as an indicator of increased morbidity. As there was no single measurement of morbidity, risk adjustment was not undertaken.

In- Hospital Mortality was determined through review of the medical record discharge status.

Risk-Adjusted In-Hospital Mortality was analyzed using unconditional logistic regression with Dead/Alive at the time of discharge as the dependent variable. Model building commenced using purposeful selection of variables for the bivariate analysis undertaken with each cohort separately. Those variables deemed clinically important and those significant at $p \leq 0.20$ in Control or Caremap bivariate analysis were then utilized in a trivariate analysis with group.

Trivariate analysis examining main effects and interactions of chosen variables with group was undertaken to further elucidate the effect of the intervention as described in Part 4.1.9.5. Variables that were significant as previously described in any of these preliminary analyses were included in the multivariate analysis.

The following variables were considered as possible clinically important predictors of mortality:

- ☐ *Group* – Caremap versus Control
- ☐ *Demographic variables* – Age, Sex, admission from lodge or institution versus own home
- ☐ *Medical Variables* – Charlson Comorbidity Index Score, number and type of complications, cognition, number/type of comorbidities, fracture type

Following construction of the final multivariate model, the Hosmer and Lemeshow Goodness of Fit test was used to determine whether the model's observed values were different than the predicted values, with a significant test indicating a poor fit of the model.

Acute care LOS was compared between the cohorts to determine if the caremap reduced the time spent in hospital following a hip fracture. LOS was calculated as number of days spent in the surgical hospital. Risk adjustment was not undertaken, as data were not available regarding the LOS in the rehabilitation institutions for the Control cohort.

Discharge Location was analyzed using χ^2 tests to compare the proportion of patients in each cohort who could be discharged directly home rather than to ongoing rehabilitation in another institution.

Readmissions during the initial six months following hip fracture for medical care related to either the hip fracture or complications arising from the hip fracture were recorded as a dichotomous variable (Yes/No). The duration of re-admissions was not captured, so only the number of readmission could be compared between the two cohorts.

Two reviewers examined re-admission records and determined whether the re-admission was considered as related to the hip fracture. Re-admissions for medical procedures unrelated to the hip fracture (i.e. cataract surgery) were excluded. Where it was unclear why the patient was re-admitted, the re-admission was considered as related to the hip fracture.

4.2.7.3. Tertiary Objectives:

Each of the variables chosen to measure differences in service delivery was compared between cohorts to quantify the process changes that occurred as a result of caremap implementation. Continuous variables were analyzed using independent t-tests while categorical variables were analyzed using χ^2 tests.

5. RESULTS

5.1. Part One

5.1.1. Demographics

Between July 1997 and September 1998, 678 eligible patients were admitted with a hip fracture prior to caremap implementation. Of these patients, 468 (69%) agreed to participate in the follow-up study. Between July 1999 and September 2000, an additional 663 eligible patients were admitted for treatment of a hip fracture following caremap implementation, with 451 (68%) patients agreeing to participate in the follow-up study (See Figure 5.1).

Participants in both cohorts, Caremap and Control, were similar in demographic and social characteristics with the exception of marital status (See Table 5.1.1). More patients in the Control cohort were widowed compared to those in the Caremap cohort ($p = 0.02$). The cohorts were also similar in terms of pre fracture functional status, number of comorbidities, fracture location and admission location (See Table 5.1.1).

5.1.2. Non-Respondents

The proportion of non-respondents was similar between cohorts ($p = 0.72$). Non-respondents were significantly more likely to be male and to be admitted from institutional settings. They experienced more postoperative complications than those patients who agreed to participate in the follow-up study and were significantly more likely to be admitted to ICU (See Table 5.1.2). In-hospital mortality was also higher in the non-respondents than respondents in both cohorts. In the Caremap cohort, non-respondents were older than respondents (p= 0.002).

5.1.3. Losses to Follow-up

At three-months post fracture, 7 (1%) patients were lost to follow-up in the Control cohort and 23 (5%) patients were lost to follow-up in the Caremap cohort. By six-months post fracture, 62 (13%) subjects in the Control cohort and 64 (14%) subjects in the Caremap cohort were deceased (p = 0.55). Of the survivors, 57 (13%) patients were lost to follow-up in the Caremap cohort while only 22 (5%) subjects were lost to follow-up in the Control cohort (p <0.001).

There were no baseline differences between patients lost to follow-up and those who completed the three-month interview in the Caremap cohort. In the Control cohort, the seven patients lost to follow-up had significantly higher baseline BFI scores (p = 0.01), and were significantly more likely to be admitted from the community (p = 0.01).

At six-months, males were more likely to be lost to follow-up than females in both cohorts, but for the most part, subjects who were lost to follow-up were similar in baseline and surgical characteristics to subjects who remained in the study (See Table 5.1.3). In the Control cohort, patients residing in lodges were more frequently lost to follow-up at six-months than those residing in institutional settings or in the community. Losses to follow-up in the Control cohort were, however, similar in baseline function as measured by the BFI and in fracture type to those who were followed out to six months at baseline (See Table 5.1.3). In contrast, patients who were lost to follow-up in the Caremap cohort had significantly better baseline function, were more likely to sustain a

IT fracture and were also more likely to discharged directly home than those who remained in the study for the entire six-month follow-up period (See Table 5.1.3).

Of the patients remaining in study at the three and six-month follow-up assessments, the only significant difference seen in baseline characteristics was that more patients in the Caremap cohort were rated as having a "moderate" Charlson Comorbidity Index compared to patients in the Control cohort who were more likely to rated as "None", indicating no comorbidities, on the comorbidity Index (See Table 5.1.4). As the Charlson index was developed to predict mortality, this difference between groups may not have clinical importance for the primary outcomes of function, HRQoL or institutionalization.

5.1.4. Patient versus Proxy Respondents

Patient respondents were used whenever possible based upon the MMSE score obtained within the first week of surgery. Interviews occurred on average 5.8 (± 6.2) days post surgery in the Control cohort and 5.8 (± 4.5) days in the Caremap cohort ($p = 0.94$). In the Control cohort, significantly fewer patients attained a MMSE score of 22 or greater; thus proxy respondents used were for 274 patients (59%). In contrast, proxy respondents were only used with 158 (35%) of the Caremap patients ($p < 0.001$).

5.1.5. Primary Objectives

5.1.5.1. Functional Recovery

Descriptive Statistics: Functional recovery as measured by the BFI was examined at four intervals in the six-months following hip fracture. No differences were seen in baseline or six-month functional levels between cohorts. However, at the five-day postoperative evaluation, the Control cohort had statistically significantly higher function while at the three-month evaluation, the Caremap cohort had a non-statistically significantly higher function (See Table 5.1.5).

In the sub-group analysis of patients with and without dementia, patients in the Caremap group without dementia demonstrated a trend towards better function over the six months post fracture period compared to the Control group ($p = 0.06$). Patients with dementia showed no significant differences in function over the six-month post fracture period between cohorts ($p = 0.37$)

By three months post fracture, 136 (32%) of patients in the Control and 134 (37%) of patients in the Caremap cohort had returned to their pre fracture functional level ($p = 0.20$). At the six-month evaluation, 159 (41%) and 143 (43%) of the Control and Caremap patients respectively, had returned to their pre fracture functional level ($p = 0.65$), with the remaining subjects reporting more dependent function post fracture.

Risk-Adjusted Functional Recovery: The three-month BFI score was chosen as the dependent variable for the risk-adjusted analysis of functional recovery to examine differences that occurred during the primary recovery period. The five-day postoperative BFI was very low in both groups and was considered as an initial measure of postoperative recovery.

Table 5.1.6 shows predictors ($p \leq 0.20$) of functional recovery through bivariate analysis undertaken with each cohort separately while Table 5.1.7 shows the results of the final multivariate analysis. The results of the trivariate analysis are shown in Appendix 9.4.3 while descriptive analyses of all variables examined in these models are shown in Appendices 9.4.1 and 9.4.2.

Group (Caremap/Control) was found to interact significantly with the patients level of social contact. Those patients in the Control cohort who had low social contact were predicted to have a significantly lower level of functional recovery than those with high social contact. In the Caremap cohort, the amount of social contact had only a small effect on functional recovery (See Table 5.1.8).

OLS linear regression was used to determine predictors of three-month functional recovery so that the significant interaction effect could be retained in the model. Decreasing age, increasing cognition, good baseline and immediate-postoperative function were all strong predictors of having good three-month post fracture function. Being admitted from and discharged to institutional care, and increasing LOS in hospital were predictors of poor three-month function (See Table 5.1.7). Gender was retained in the model because it was considered a clinically important variable, despite being a non-significant predictor of three-month function. Balance problems prior to fracture also demonstrated a significant interaction between groups in the trivariate analysis (See Appendix 9.4.3). However, neither the main effect nor the interaction of group with this variable retained significance in the multivariate analysis; thus this variable was not considered further.

5.1.5.2. HRQoL

Descriptive Statistics: Subjects in both cohorts reported similar levels of physical and mental health at all measurement points (See Table 5.1.9). Although some comparisons were statistically significant, the differences between cohorts were never large enough to be considered clinically important. The RAND scoring system uses norm-based scoring with a mean of 50 and a standard deviation of 10. At no time were groups even five points (one-half of a standard deviation) apart, a difference considered clinically non-significant.[174] Using two-way repeated measures Analysis of Variance (ANOVA), no differences were seen between groups nor did interactions occur between groups at any interval ($p > 0.05$). Changes over time were significant for both cohorts ($p < 0.001$). No differences were seen between cohorts in the rate of change that occurred in the first three months postoperatively as measured by an independent t-test (See Table 5.1.10).

More proxy respondents were used for the Control cohort than the Caremap cohort; thus these results must be considered with caution. There was also a higher level of non-response in the Control cohort on the MHC score, where the questions were about feelings rather than observable behaviours.

Risk-adjusted HRQoL: Tables 5.1.11 and 5.1.13 show predictors ($p \leq 0.20$) of HRQoL using the PHC and MHC scores respectively through bivariate analysis. An analysis of these two components of HRQoL was undertaken with each cohort separately using OLS linear regression. Tables 5.1.12 and 5.1.14 show the results of the final multivariate analysis for each of these two components of HRQoL analyzed using OLS linear regression. The results of the trivariate analysis undertaken with ANCOVA are shown in Appendices 9.5.3 and 9.5.5 while descriptive analyses of all variables examined in these models are shown in Appendices 9.5.1 and 9.5.2. Although there was interaction seen between group and one clinical variable in both the PHC and MHC trivariate analysis, neither the interaction effect nor the main effects of these variables were significant in the multivariate models; thus these interactions were not considered further.

A lower three-month PHC score was associated with increasing LOS in hospital or being discharged to either rehabilitation or an institution. Increasing baseline PHC score was a strong predictor of higher PHC scores at the three-month evaluation (See Table 5.1.12). Group (Caremap/Control) and gender were not significant predictors of the PHC score at three months following fracture. However, they were retained in the model because they were considered clinically important variables. The amount of variance in the PHC score explained by the final model was only 0.18, indicating that the factors chosen predicted only a small amount of the three-month PHC score variance.

A lower three-month MHC score was associated with having a mild Charlson comorbidity index, balance problems prior to fracture, other fractures at the time of hip fracture, and having a proxy respondent answer the questionnaire (See Table 5.1.14). An increasing baseline MHC score was a strong predictor of a good three-month MHC score. Neither group (Caremap/Control) nor gender was a significant predictor of the MHC score at three months post fracture. However, both group and gender were retained in the model because they were considered clinically important variables.

5.1.5.3. Institutionalization

Descriptive Statistics: At commencement of the study, 115 (25%) patients in the Control cohort and 114 (26%) in the Caremap cohort were already residing in an institution, and were excluded from this analysis. By six months following fracture, an additional 58 (20%) and 46 (18%) subjects in the Control and Caremap cohort respectively required institutional care (p = 0.66).

Risk-Adjusted Institutionalization: To determine predictors of institutionalization, unconditional logistic regression modelling was undertaken. Table

5.1.15 shows the results of the bivariate analysis undertaken with each cohort separately. The trivariate analysis results are shown in Appendix 9.6.3 with the descriptive analyses of all variables utilized in the models displayed in Appendices 9.6.1 and 9.6.2.

Interaction between Group (Control/Caremap) and the patients' level of social contact was also seen in this model. Those patients with low social contact in the Control cohort were at significantly increased odds of institutionalization compared to those patients in the Caremap cohort with low social contact or patients from either cohort who had high social contact (See Table 5.1.17).

In addition to the effect of social contact and group, increasing age, poor cognition at baseline, and living in a lodge pre fracture were all significant predictors of requiring institutional care by six months following a hip fracture (See Table 5.1.16). The BFI score within the first week following surgery also predicted institutionalization; as the postoperative BFI increased, the likelihood of institutionalization at six months decreased. Because it was considered a clinically important variable, gender was retained in the model despite being a non-significant predictor of six-month institutionalization.

Figure 5.1 Flow Chart

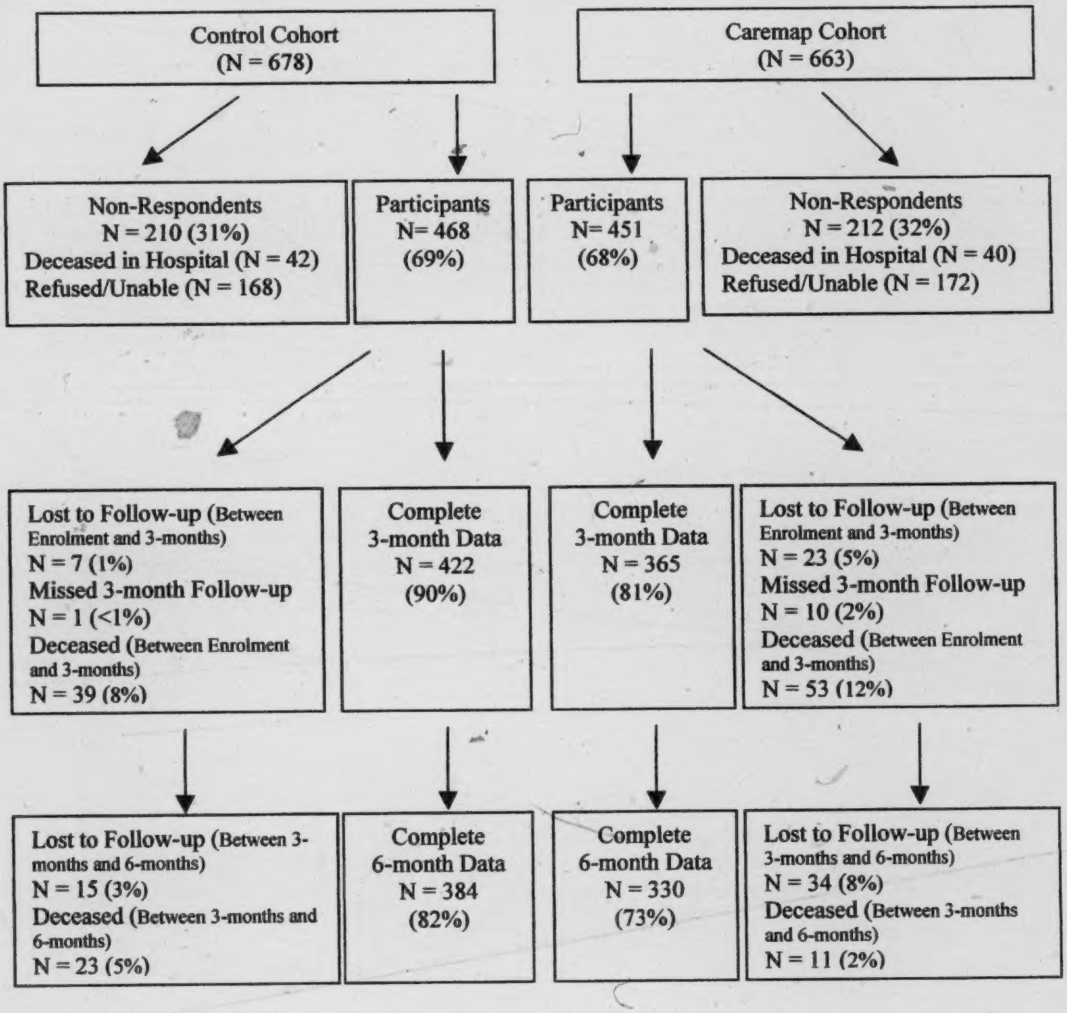
Control Cohort (N = 678)
Caremap Cohort (N = 663)
Non-Respondents N = 210 (31%) Deceased in Hospital (N = 42) Refused/Unable (N = 168)
Participants N= 468 (69%)
Participants N= 451 (68%)
Non-Respondents N = 212 (32%) Deceased in Hospital (N = 40) Refused/Unable (N = 172)
Lost to Follow-up (Between Enrolment and 3-months) N = 7 (1%) Missed 3-month Follow-up N = 1 (<1%) Deceased (Between Enrolment and 3-months) N = 39 (8%)
Complete 3-month Data N = 422 (90%)
Complete 3-month Data N = 365 (81%)
Lost to Follow-up (Between Enrolment and 3-months) N = 23 (5%) Missed 3-month Follow-up N = 10 (2%) Deceased (Between Enrolment and 3-months) N = 53 (12%)
Lost to Follow-up (Between 3-months and 6-months) N = 15 (3%) Deceased (Between 3-months and 6-months) N = 23 (5%)
Complete 6-month Data N = 384 (82%)
Complete 6-month Data N = 330 (73%)
Lost to Follow-up (Between 3-months and 6-months) N = 34 (8%) Deceased (Between 3-months and 6-months) N = 11 (2%)

Table 5.1.1. Baseline Demographics of Patients Enrolled in Study Cohorts Between July 1996 and September 1997 (Control) and July 1999 and September 2000 (Caremap)

Variable	**Control** (N = 468)	**Caremap** (N = 451)	**P-Value**
Mean Age (SD)	81.7 (7.6)	81.7 (7.8)	0.96 [a]
Gender (%)			0.75[b]
Female	361 (77)	352 (78)	
Male	107 (23)	99 (22)	
Social Contact (%)			0.33 [b]
None/Weekly	132 (29)	117 (26)	
Frequently/Daily	321 (71)	329 (74)	
Marital Status (%)			0.02 [b]
Married	114 (24)	146 (32)	
Widowed/Single	354 (76)	305 (68)	
Charlson Comorbid Index (%)			0.1 [b]
None	134 (29)	101 (22.5)	
Mild (1-2 Conditions)	215 (46)	226 (50)	
Moderate (3-4 Conditions)	89 (19)	101 (22.5)	
Severe (≥ 5 Conditions)	39 (6)	23 (5)	
Mean Baseline BFI (SD)	85.1 (20.9)	85.1 (20.6)	1.00 [a]
Fracture Type (%)			0.09 [b]
FN	237 (51)	237(53)	
IT	228 (48)	204 (45)	
ST	3 (1)	10 (2)	
Admitted From (%)			0.11 [b]
Community	280 (60)	287 (64)	
Lodge	73 (15)	49 (11)	
Institution	115 (25)	115 (25)	

[a] Two-Sample Independent T-test

[b] Chi Square test

LEGEND: SD = Standard Deviation; BFI = Barthel Functional Index; FN= Femoral Neck; IT = Intertrochanteric; ST = Subtrochanteric

Table 5.1.2. Demographic Characteristics of Study Participants vs. Non-Participants

	Control			Caremap		
Variable	Respondents (N = 468)	Non-Respondents (N = 210)	P-Value	Respondents (N = 451)	Non-Respondents (N = 212)	P-Value
Mean Age (SD)	81.8 (7.6)	82.6 (8.2)	0.23^a	81.8 (7.8)	83.8 (7.8)	0.002^a
Gender (%)			0.01^b			0.03^b
Female	361 (77)	141 (67)		352 (78)	148 (70)	
Male	107 (23)	69 (33)		99 (22)	64 (30)	
Charlson Comorbid Index (%)			0.27^b			0.14^b
None	134 (29)	46 (22)		101 (22)	39 (18)	
Mild	215 (46)	103 (49)		226 (50)	103 (49)	
Moderate	89 (19)	43 (21)		101(23)	50 (24)	
Severe	39 (6)	18 (8)		23 (5)	20 (9)	
Fracture Type(%)			0.67^b			0.70^b
FN	237 (51)	114 (54)		237(53)	108 (51)	
IT	228 (48)	95 (45)		204 (45)	101 (48)	
ST	3 (1)	1 (1)		10 (2)	3 (1)	
Admitted From (%)			0.01^b			0.02^b
Community	280 (60)	111 (53)		287 (64)	103 (49)	
Lodge	73 (15)	25 (12)		49 (11)	28 (13)	
Institution	115 (25)	74 (35)		115 (25)	81 (38)	
Stroke Postop (%)	6 (3)	3 (<1)	0.03^b	5 (2)	3 (<1)	0.12^b
ICU Admission (%)	14 (7)	6 (1)	$<0.001^b$	6 (3)	3 (<1)	0.03^b
>3 Postop Complications	32 (7)	26 (12)	0.01^b	15 (3)	22 (10)	0.001^b
Discharged to (%)			$<0.001^b$			$<0.001^b$
Death	10 (2)	42 (20)		8 (2)	40 (19)	
Community	19 (4)	7 (3)		40 (9)	11 (5)	
Lodge	2 (<1)	0 (0)		4 (1)	0 (0)	
Institution	107 (23)	59 (28)		120 (27)	63 (30)	
Rehabilitation	330 (70)	102 (49)		279 (62)	98 (46)	

[a] Two-Sample Independent T-test

[b] Chi Square test

LEGEND: SD = Standard Deviation; ICU = Intensive Care Unit; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.3. Comparison of Subjects Who Completed the 6-month Follow-up Visit and Subjects Who were Lost to Follow-up*

	Control			Caremap		
Variable	Six-Month Respondents (N = 384)	Losses to Follow-up (N = 22)	P-Value	Six-Month Respondents (N = 330)	Losses to Follow-up (N = 57)	P-Value
Mean Age (SD)	81.2 (7.5)	83.6 (8.2)	0.15[a]	81.6 (7.6)	79.9 (7.9)	0.12[a]
Gender (%)			0.03[b]			0.12[b]
Female	306 (80)	13 (59)		269 (81)	42 (74)	
Male	78 (20)	9 (41)		61 (19)	15 (26)	
Charlson Comorbid Index (%)			0.99[b]			0.31[b]
None	120 (31)	7 (32)		84 (26)	11 (19)	
Mild	174 (45)	10 (46)		160 (48)	32 (56)	
Moderate	67 (17)	4 (18)		75 (23)	10 (18)	
Severe	23 (6)	1 (4)		11 (3)	4 (7)	
Fracture Type (%)			0.46[b]			0.04[b]
FN	193 (50)	14 (64)		178 (54)	28 (49)	
IT	189 (49)	8 (36)		147 (45)	25 (44)	
ST	2 (1)	0		5 (1)	4 (7)	
Admitted From(%)			0.01[b]			0.11[b]
Community	246 (65)	11 (50)		215 (65)	45 (79)	
Lodge	50 (13)	8 (37)		40 (12)	3 (5)	
Institution	88 (23)	3 (14)		75 (23)	9 (16)	
Poor Cognition (%)	240 (63)	9 (41)	0.07[b]	134 (41)	19 (33)	0.38[b]
Mean Baseline BFI Score (%)	87.1 (19.5)	86.9 (23.7)	0.97[b]	86.6 (18.9)	91.9 (13.3)	0.03[a]
Discharged to (%)			0.74[b]			0.01[b]
Community/Lodge	20 (5)	1 (5)		33 (10)	11 (19)	
Institution	97 (25)	4 (18)		83 (25)	12 (21)	
Rehabilitation	330 (70)	17 (77)		214 (65)	34 (60)	

* Excludes Deceased Subjects

[a] Independent T-test

[b] Chi Square test

LEGEND: SD = Standard Deviation; BFI = Barthel Functional Index; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.4.* Comparison of Baseline Characteristics of Control and Cohort Subjects Who Completed the 6-month Follow-up Visit

	Control	Caremap	P-Value
Variable	Six-Month Respondents (N = 384)	Six-Month Respondents (N = 330)	
Mean Age (SD)	81.2 (7.5)	81.6 (7.6)	0.51 [a]
Gender (%)			0.57 [b]
Female	306 (80)	269 (81)	
Male	78 (20)	61 (19)	
Charlson Comorbid Index (%)			0.05 [b]
None	120 (31)	84 (26)	
Mild	174 (45)	160 (48)	
Moderate	67 (17)	75 (23)	
Severe	23 (6)	11 (3)	
Fracture Type (%)			0.23 [b]
FN	193 (50)	178 (54)	
IT	189 (49)	147 (45)	
ST	2 (1)	5 (1)	
Admitted From (%)			0.88 [b]
Community	246 (65)	215 (65)	
Lodge	50 (13)	40 (12)	
Institution	88 (23)	75 (23)	
Mean Baseline BFI Score (%)	87.1 (19.5)	86.6 (18.9)	0.74 [a]

* Excludes Deceased Subjects

[a] Independent T-test

[b] Chi Square test

LEGEND: SD = Standard Deviation; BFI = Barthel Functional Index; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.5. Descriptive Barthel Functional Index Scores at Each Assessment Point

Variable	**Control Mean (SD)**	**N**	**Caremap Mean (SD)**	**N**	**P-Value**
Baseline (Pre- Fracture)	85.1 (20.9)	467	85.1 (20.6)	451	1.00 [a]
Five Days Postop	39.4 (20.3)	465	35.1 (19.4)	438	0.001 [a]
Three Months Postop	69.9 (30.9)	422	73.4 (29.4)	365	0.12 [a]
Six Months Postop	72.1 (31.1)	384	73.9 (30.8)	331	0.46 [a]

[a] Independent T-test

LEGEND: SD = Standard Deviation

Table 5.1.6. Predictors of 3-Month Barthel Functional Index Scores: Bivariate Analysis of Each Cohort Separately

	Control			Caremap		
Variable	$\beta^{\ddagger}$	SE	P-Value	$\beta^{\ddagger}$	SE	P-Value
Age (per year increase)	-1.2	0.19	< 0.001	-1.3	0.19	< 0.001
Gender (Female = 0)	-1.4	3.6	0.69	-1.2	3.9	0.75
Baseline BFI Score (per unit increase)	1.07	0.05	< 0.001	1.04	0.06	< 0.001
Postop BFI Score (per unit increase)	0.83	0.06	< 0.001	0.91	0.07	< 0.001
Time to Rehabilitation (per day increase)	0.37	0.85	0.67	-1.4	1.0	0.16
LOS (per day increase)	-0.44	0.24	0.07	-0.25	0.18	0.16
Admitted From: *Community**						
Lodge	-14.2	3.9	< 0.001	-10.6	3.7	0.004
Institution	-47.5	2.9	< 0.001	-46.8	2.8	< 0.001
Discharged to: *Community**						
Rehabilitation	-17.0	5.4	0.002	-9.3	3.8	0.01
Institution	-62.0	5.8	< 0.001	-54.3	4.2	< 0.001
Cognition (≥ 22 MMSE = 0)	-31.1	2.7	< 0.001	-36.2	2.5	< 0.001
Charlson Comorbidity: *None**						
Mild	-15.1	3.4	< 0.001	-17.6	3.7	< 0.001
Moderate	-29.0	4.2	< 0.001	-15.2	4.3	0.001
Severe	-23.5	6.2	< 0.001	-28.4	7.7	< 0.001
Fracture Site: *FN**						
IT	-2.7	2.1	0.37	-10.1	3.1	0.001
ST	-23.9	22.0	0.28	-16.4	10.5	0.12
Fracture Fixation: *Arthroplasty**						
Compression Screw Slide Plate	-0.59	0.34	0.86	-10.1	3.3	0.002
Cannulated Screws	11.3	4.2	0.007	-3.5	5.2	0.50
Intramedullary Nail	0^{+}			-3.1	10.5	0.77
Postop Stroke (No = 0)	-26.0	17.9	0.13	-26.0	20.8	0.21
Balance Problems Preop (No =0)	-16.8	5.0	0.001	12.8	8.0	0.11
MSK Problems Preop (No=0)	-7.3	3.6	0.04	-0.24	3.2	0.94
Preop Activity Level: *Independent**						
Mechanical Aids	-13.4	3.1	< 0.001	-11.9	3.0	< 0.001
Dependent	-41.8	5.1	< 0.001	-49.1	5.9	< 0.001
Marital Status (Married = 0)	-8.3	3.4	0.02	-4.8	3.3	0.14
Social Contact (Daily/Frequently = 0)	-38.9	2.9	< 0.001	-26.5	3.4	< 0.001

* = Reference Category; $^{+}$ = Zero Cell; ‡ Regression Coefficient

LEGEND: SE= Standard Error; BFI = Barthel Functional Index; LOS = Length of Stay; MSK = Musculoskeletal; MMSE = Mini Mental Status Examination; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.7. Predictors of 3-Month Barthel Functional Index: Multivariate Analysis

Variable		$\beta^{\ddagger}$	SE	P-Value
Group (Caremap = 0)		.063	1.6	0.70
Age (per Year increase)		-0.22	0.10	0.24
Gender (female = 0)		-0.19	1.7	0.11
Baseline BFI Score (per unit increase)		0.44	0.05	< 0.001
Postop BFI Score (per unit increase)		0.19	0.04	< 0.001
Admitted From:	*Community**	0	NA	
	Lodge	-4.8	2.0	0.02
	Institution	-12.3	3.0	< 0.001
Discharged to:	*Community**	0		
	Rehabilitation	-1.7	2.7	0.54
	Institution	-13.6	3.8	< 0.001
LOS (per day increase)		-0.34	0.1	< 0.001
Cognition ($\geq$ 22 MMSE = 0)		-9.5	1.7	< 0.001
Social Contact: (Daily/Frequently = 0)		-0.72	2.5	0.77
Group X Social Contact Interaction		-12.0	3.1	< 0.001

* = Reference Category; ‡ Regression Coefficient

$R^2 = 0.80$

LEGEND: SE= Standard Error; BFI = Barthel Functional Index; LOS = Length of Stay; MMSE = Mini Mental Status Examination

Table 5.1.8. Predicted 3-month Barthel Functional Index Scores with Interaction between Study Cohorts and Amount of Social Contact *

*After adjusting for the above variables, an 81.2 year old subject with pre fracture and five-day post fracture BFI scores of 86.9 and 39.1 respectively, who stayed in hospital 11.5 days would have a predicted 3-month post fracture BFI of:

	Control	**Caremap**
None/Weekly Social Support (95% Confidence Intervals)	60.2 (56.2, 64.2)	68.9 (64.5, 73.3)
Daily/ Frequently Social Support (95% Confidence Intervals)	75.3 (72.8, 77.9)	74.1 (71.4, 76.8)

LEGEND: BFI =Barthel Functional Index

Table 5.1.9. Descriptive RAND-12 Scores

	Control				Caremap			
Variable	Mean PHC (SD)	N	Mean MHC (SD)	N	Mean PHC (SD)	N	Mean MHC (SD)	N
Baseline (Pre-Fracture)	45.1 (10.5)	440	42.3 (11.4)	424	44.3 (10.3)	440	43.9 (10.9)	421
Three Months Postop	40.4 (9.3)	374	40.6 (11.1)	354	39.4 (8.2)	363	40.4 (11.1)	359
Six Months Postop	41.4 (9.5)	341	43.0 (11.6)	318	41.3 (9.1)	330	40.7 (11.8)	329

LEGEND: PHC = Physical Health Composite; MHC = Mental Health Composite; SD = Standard Deviation

Table 5.1.10. Percentage Change Between Baseline and 3-Month RAND SF-12 Scores Standardized to Baseline Scores

Variable	**Control**	**N**	**Caremap**	**N**	**P-Value**
Change in PHC (SD)	-8.0 (26.0)	357	-9.0 (24)	355	0.72 [a]
Change in MHC (SD)	-2.0 (31.0)	324	-6.0 (26)	332	0.07 [a]

[a] Two Sample Independent T-test

LEGEND: PHC = Physical Health Composite; MHC = Mental Health Composite

Table 5.1.11. Predictors of 3-Month Physical Health Composite Scores: Bivariate Analysis of Each Cohort Separately

	Control			**Caremap**		
Variable	$\beta^{\ddagger}$	SE	P-Value	$\beta^{\ddagger}$	SE	P-Value
Age (per year increase)	-0.17	0.06	0.009	-0.16	0.06	0.005
Gender (Female = 0)	0.45	1.1	0.70	-0.26	1.1	0.81
Baseline PHC Score (per unit increase)	0.35	0.04	< 0.001	0.33	0.04	< 0.001
Baseline MHC Score (per unit increase)	0.26	0.04	< 0.001	0.27	0.04	< 0.001
Baseline BFI Score (per unit increase)	0.08	0.03	0.002	0.09	0.02	< 0.001
Postop BFI Score (per unit increase)	0.08	0.02	0.002	0.09	0.02	< 0.001
LOS (per day increase)	-0.26	0.08	0.001	-0.13	0.05	0.008
Admitted From: *Community**						
Lodge	-3.6	1.4	0.01	-0.54	1.3	0.69
Institution	-2.9	1.2	0.01	-3.5	1.0	0.001
Discharged to: *Community**						
Rehabilitation	-5.1	2.1	0.016	-4.3	1.4	0.002
Institution	-7.4	2.3	0.001	-7.1	1.5	< 0.001
Cognition (≥ 22 MMSE = 0)	-3.5	0.96	< 0.001	-3.3	0.87	< 0.001
Charlson Comorbidity: *None**						
Mild	-2.3	1.1	0.04	-1.9	1.1	0.07
Moderate	-4.7	1.4	0.001	-2.0	1.2	0.12
Severe	-4.6	2.1	0.03	-6.0	2.2	0.007
Fracture Site: *FN**						
IT	0	0.97	1.0	-2.1	0.87	0.01
ST	-6.2	6.7	0.35	0.78	2.9	0.79
Fracture Fixation: *Arthroplasty**						
Compression Screw Slide Plate	0.70	1.1	0.52	-2.0	0.91	0.03
Cannulated Screws	2.3	1.4	0.09	-1.0	2.9	0.73
Intramedullary Nail	0^{+}			2.5	1.5	0.10
Balance Problems Preop (No =0)	-3.4	1.6	0.04	-3.1	2.2	0.17
MSK Problems Preop (No=0)	-1.1	1.2	0.32	-1.3	0.89	0.13
Presence of Other Fractures (No=0)	-2.5	1.6	0.13	-0.51	2.2	0.81
Preop Activity Level: *Independent**						
Mechanical Aids	-5.2	1.0	< 0.001	-4.0	0.89	< 0.001
Dependent	-4.3	1.8	0.02	-2.7	1.8	0.12
Marital Status (Married = 0)	-1.8	1.1	0.09	0.98	0.92	0.29
Social Contact (Daily/Frequently = 0)	-1.9	1.2	0.10	-1.4	1.0	0.16
Postop Myocardial Infarct (No=0)	4.8	3.8	0.21	-5.7	4.1	0.17
Use of a Proxy Respondent (No=0)	-3.5	0.96	< 0.001	-3.1	0.87	< 0.001

* = Reference Category; $^{+}$ = Zero Cell; ‡ Regression Coefficient

LEGEND: SE= Standard Error; PHC = Physical Health Composite; MHC = Mental Health Composite; BFI = Barthel Functional Index; LOS = Length of Stay; MSK = Musculoskeletal; MMSE = Mini Mental Status Examination; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.12. Predictors of 3-Month Physical Composite Score: Multivariate Analysis

Variable		β[‡]	SE	P-Value
Group (Caremap = 0)		0.57	0.61	0.36
Gender (female = 0)		-0.21	0.74	0.78
Baseline PHC Score (per unit increase)		0.30	0.03	< 0.001
LOS (per day increase)		-0.11	0.04	0.01
Discharged to:	*Community**			
	Rehabilitation	-2.8	1.1	0.01
	Institution	-4.2	1.3	0.001

* = Reference Category; ‡ Regression Coefficient

$R^2 = 0.18$

LEGEND: SE= Standard Error; PHC = Physical Health Composite; LOS = Length of Stay

Table 5.1.13. Predictors of 3-Month Mental Health Composite Scores: Bivariate Analysis of Each Cohort Separately

	Control			Caremap		
Variable	$\beta^{\ddagger}$	SE	P-Value	$\beta^{\ddagger}$	SE	P-Value
Age (per year increase)	-0.26	0.08	0.001	-0.29	0.08	< 0.001
Gender (Female = 0)	1.3	1.4	0.36	2.0	1.5	0.17
Baseline PHC Score (per unit increase)	0.39	0.05	< 0.001	0.38	0.05	< 0.001
Baseline MHC Score (per unit increase)	0.51	0.05	< 0.001	0.56	0.5	< 0.001
Baseline BFI Score (per unit increase)	0.13	0.03	< 0.001	0.18	0.03	< 0.001
Postop BFI Score (per unit increase)	0.14	0.03	< 0.001	0.17	0.03	< 0.001
LOS (per day increase)	-0.32	0.10	0.001	-0.91	0.07	0.17
Admitted From: *Community**						
Lodge	-4.1	1.7	0.01	-2.8	1.8	0.12
Institution	-7.2	1.4	< 0.001	-6.4	1.4	< 0.001
Discharged to: *Community**						
Rehabilitation	-1.4	2.7	0.57	-7.4	1.8	< 0.001
Institution	-8.5	2.8	0.003	-12.0	2.1	< 0.001
Cognition (≥ 22 MMSE = 0)	-6.34	1.1	< 0.001	-6.2	1.2	< 0.001
Charlson Comorbidity: *None**						
Mild	-4.6	1.3	0.001	-4.9	1.4	0.001
Moderate	-6.8	1.7	< 0.001	-2.7	1.7	0.11
Severe	-8.5	2.6	0.001	-6.8	3.0	0.02
Fracture Site: *FN**						
IT	-2.3	1.2	0.05	-2.0	1.2	0.10
ST	-13.0	7.9	0.1	-1.1	4.0	0.77
Fracture Fixation: *Arthroplasty**						
Compression Screw Slide Plate	-1.7	1.3	0.20	-1.3	1.3	0.03
Cannulated Screws	1.6	1.6	0.32	2.6	2.0	0.19
Intramedullary Nail	0^{+}			2.1	4.3	0.63
Presence of Other Fractures (No=0)	-1.8	2.1	0.39	-3.4	2.9	0.24
Balance Problems Preop (No =0)	-6.4	1.9	0.001	-6.1	3.0	0.04
Preop Activity Level: *Independent**						
Mechanical Aids	-5.3	1.3	0.007	-3.6	1.2	0.003
Dependent	-5.8	2.2	< 0.001	-6.5	2.4	0.008
Marital Status (Married = 0)	-1.7	1.3	0.21	-2.1	1.2	0.10
Social Contact (Daily/Frequently = 0)	-1.2	1.4	0.42	-3.6	-2.6	0.10
Use of a Proxy Respondent (No=0)	-6.4	1.1	< 0.001	-6.6	1.2	< 0.001

* = Reference Category + = Zero Cell ± = Complete Separation ‡ = Regression Coefficient

LEGEND: SE= Standard Error; MHC = Mental Health Composite; PHC = Physical Health Composite BFI = Barthel Functional Index; LOS = Length of Stay; MMSE = Mini Mental Status Examination; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.14. Predictors of 3-Month Mental Composite Score: Multivariate Analysis

Variable	$\beta^{\ddagger}$	SE	P-Value
Group (Caremap = 0)	1.3	0.75	0.09
Gender (female = 0)	1.2	0.90	0.20
Baseline MHC Score (per unit increase)	0.46	0.04	< 0.001
Charlson Comorbidity: *None**			
Mild	-2.5	0.90	0.01
Moderate	-1.8	1.1	0.10
Severe	-2.3	1.8	0.19
Presence of Other Fractures (No=0)	-3.7	1.5	0.02
Balance Problems Preop (No =0)	-3.3	1.5	0.04
Use of a Proxy Respondent (No=0)	-3.4	0.78	< 0.001

* = Reference Category; ‡ Regression Coefficient
$R^2 = 0.32$
LEGEND: SE= Standard Error; MHC = Mental Health Composite

Table 5.1.15. Predictors of Institutionalization at 6-Months Post Hip Fracture: Bivariate Analysis of Each Cohort Separately

	Control			**Caremap**		
Variable	**OR**	**95% CI**	**P-Value**	**OR**	**95% CI**	**P-Value**
Age (per Year increase)	1.1	1.07, 1.17	< 0.001	1.2	1.1, 1.2	< 0.001
Gender (Female = 0)	0.71	0.32, 1.5	0.38	0.99	0.44, 2.2	0.97
Baseline BFI (per unit increase)	0.93	0.91, 0.96	< 0.001	0.94	0.91, 0.96	< 0.001
Postop BFI (per unit increase)	0.96	0.94, 0.98	< 0.001	0.95	0.93, 0.97	< 0.001
Time to Rehabilitation (per day increase)	1.1	0.99, 1.3	0.07	1.2	0.94, 1.5	0.16
LOS (per day increase)	1.1	1.1, 1.2	< 0.001	1.07	1.03, 1.1	< 0.001
Admission (Community = 0)	4.6	2.4, 8.8	< 0.001	3.7	1.8, 7.8	0.001
Cognition (≥ 22 MMSE = 0)	13.7	5.6, 33.1	< 0.001	4.7	2.4, 9.2	< 0.001
Balance Problems Preop (No=0)	3.2	1.4, 7.4	0.006	1.1	0.23, 5.5	0.87
Charlson Comorbidity:			0.008			0.21
*None**	1.0			1.0		
Mild	3.4	1.6, 7.6	0.002	2.4	1.1, 5.4	0.04
Moderate	4.7	1.8, 11.8	0.002	1.8	0.66, 4.6	0.26
Severe	3.0	0.82, 11.1	0.1	1.3	0.14, 12.2	0.81
Fracture Site:			0.12			0.55
*FN**	1.0			1.0		
IT	1.7	0.96, 3.1	0.07	1.4	0.75, 2.7	0.28
ST	5.5	0.33, 91.5	0.23	0^+		
Fixation:			0.01			0.33
*Arthroplasty**	1.0			1.0		
Compression Screw Slide Plate	1.7	0.91, 3.3	0.1	1.6	0.80, 3.1	0.20
Cannulated Screws	0.47	0.18, 1.2	0.13	0.84	0.26, 2.7	0.78
Postop Stroke (No=0)	8.4	0.75, 94.6	0.08	0^+		
Postop Myocardial Infarct (No=0)	1.4	0.14, 13.4	0.79	9.4	0.84, 106.1	0.07
Postop Confusion (No=0)	4.1	2.1, 7.9	< 0.001	3.3	1.6, 6.5	0.001
Baseline Activity:			< 0.001			0.003
*Dependent**	1.0			1.0		
Mechanical Aids Used	0.35	0.10, 1.3	0.10	0.36	0.07, 1.9	0.004
Independent	0.14	0.04, 0.47	0.002	0.14	0.03, 0.73	0.02
Social Contact (Frequently/Daily = 0)	5.8	2.9, 11.5	< 0.001	1.7	0.72, 4.1	0.23
Marital Status (Married = 0)	2.1	1.0, 4.2	0.047	2.4	1.1, 5.0	0.03

* Reference Category; + Complete Separation

LEGEND: OR=Odds Ratio; CI= Confidence Intervals; BFI = Barthel Functional Index; LOS = Length of Stay; MMSE = Mini Mental Status Examination ; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.1.16. **Predictors of Institutionalization 6-Month Post Hip Fracture: Multivariate Analysis**

Variable	OR	95% CI	P-Value
Age (per year increase)	1.1	1.06, 1.15	< 0.001
Gender (Female = 0)	1.1	0.53, 2.2	0.84
Postop BFI (per unit increase)	0.97	0.95, 0.99	< 0.001
Admission (Community = 0)	2.5	1.4, 4.5	0.003
Cognition (≥ 22 MMSE = 0)	3.6	2.0, 6.4	< 0.001
Group (Caremap = 0)	0.65	0.35, 1.2	0.17
Social Contact (Frequently/Daily = 0)	1.4	0.50, 3.7	0.54
Group X Social Contact Interaction	3.5	0.96, 12.9	0.058

* Reference Category
Hosmer and Lemeshow Goodness of fit $\chi 2$ test = 0.33
LEGEND: OR=Odds Ratio; CI= Confidence Intervals; BFI = Barthel Functional Index

Table 5.1.17 **Odds Ratio for Institutionalization Depicting Interaction between Social Support and Group**

		Group	
		Caremap	Control
Social Contact	Frequently or Daily (95% confidence interval)	1.0[1]	0.65[2] (0.35, 1.2)
	None or One Time/week (95% confidence interval)	1.4[3] (0.5, 3.7)	3.2[4] (1.34, 7.46)

[1] $e^{0} = 1.0$

[2] $e^{-0.43} = 0.65$

[3] $e^{0.32} = 1.4$

[4] $e^{-0.43+0.32+1.26} = 3.2$*

*See Appendix 9.6 for calculation of 95% confidence intervals

5.2. Part Two

5.2.1. Secondary Objectives

5.2.1.1. Demographics

To measure the in-hospital effects of caremap implementation, chart reviews were performed on all eligible patients admitted to hospital between July 1997 and September 1998 (Control cohort) and July 1999 and September 2000 (Caremap cohort). By including all eligible patients, I determined the effect of caremap implementation on in-hospital morbidity, in-hospital mortality and health service utilization on all patients, including the "sickest" patients not involved in the follow-up cohort.

The two cohorts were similar in age, gender distribution and Charlson Comorbidity Index, but significantly more subjects in the Caremap cohort were diagnosed with dementia on admission (See Table 5.2.1). Further, significantly more Caremap patients were diagnosed with arrhythmias and congestive heart failure than Control patients preoperatively (See Table 5.2.1).

5.2.1.2. Morbidity

Following surgery for fracture fixation, there was a trend towards more patients in the Control than the Caremap cohort to require ICU admission to attain medical stability (P = 0.06). Further, significantly more patients in the Control cohort had arrythymias, congestive heart failure and pulmonary edema postoperatively (See Table 5.2.2).

A significant difference was seen in cognition five days postoperatively as measured using the MMSE. In the Control cohort, the majority of patients scored less than 22/30, indicating cognitive impairment while in the Caremap cohort, the majority of patients scored 22/30 or greater demonstrating minimal or no cognitive impairment (See Table 5.2.2).

The incidence of pressure ulcers was significantly reduced in the Caremap cohort with trends to reduced urinary tract infections (UTI), electrolyte imbalances, angina episodes, gastro-intestinal (GI) bleeding, and respiratory complications (excluding pneumonia) in the Caremap as compared to the Control cohort (See Table 5.2.2). No differences were seen in incidence of pneumonia, postoperative stroke, pulmonary emboli or myocardial infarctions between the groups, although with the exception of pneumonia, these were universally infrequent complications. The incidence of septic shock doubled in the Caremap group to 6 (1%) from 3 (0.5%) in the Control cohort (p = 0.34).

5.2.1.3. Mortality

Mortality: Of the 1341 eligible subjects, 52 (8%) of the Control cohort and 48 (7%) of the Caremap cohort died in-hospital (p = 0.83).

Risk-Adjusted Mortality: In-hospital mortality was analyzed using unconditional logistic regression. Bivariate analysis undertaken with each cohort individually was used to determine what clinical factors were associated with mortality in each cohort (See Table 5.2.3). The trivariate analysis results are shown in Appendix 9.7.3 with the descriptive analyses of all variables utilized in the models displayed in Appendices 9.7.1 and 9.7.2.

Group (Control/Caremap) was not found to be a significant predictor of mortality, nor were interactions between group and significant clinical factors seen (P > 0.05). In the multivariate analysis, increasing age and being male were significant predictors of in-hospital mortality, as was having cardiac disease, or renal failure prior to fracture (See Table 5.2.4). The presence of malnutrition at admission to hospital was a weak predictor of in-hospital mortality. Postoperatively, requiring ICU admission was a significant predictor of mortality (See Table 5.2.4). Further, having a stroke, myocardial infarct, GI bleed or developing septic shock, renal failure, pneumonia or respiratory problems following surgery increased the odds of dying in hospital (See Table 5.2.4).

5.2.1.4. Health Service Utilization:

Unadjusted LOS was two days longer in the Caremap than the Control cohort (See Table 5.2.5). Because LOS is a skewed distribution due to a small number of subjects staying for a prolonged period, the difference between groups was analyzed using the non-parametric Mann Whitney U test, and was found to be highly significant ($p < 0.001$). Total LOS including time spent in the rehabilitation or sub-acute facility could not be analyzed because the data from the Control cohort were not available.

Discharge Location was also significantly different between the groups with more patients in the Caremap cohort being discharged directly home rather than to a sub-acute rehabilitation facility (See Table 5.2.5).

The number of **re-admissions** over the initial six- months post fracture was significantly lower in the Caremap compared to the Control cohort (See Table 5.2.5). Only the count of re-admissions was available for analysis, as data regarding LOS for each re-admission was not captured.

5.2.2. Tertiary Objectives

5.2.2.1. *Differences in Medication Regimes*

Significant reductions were seen in the usage of Codeine and Demerol for postoperative analgesia in the Caremap cohort with an increase in Morphine use (See Table 5.2.6). The majority of patients in the Caremap cohort were only exposed to one narcotic, while in the Control cohort, almost 80% received multiple narcotics.

The number of different laxatives used was significantly decreased in the Caremap as compared to the Control cohort (See Table 5.2.6). More patients in the Control than the Caremap cohort did not receive any laxatives postoperatively.

Anticoagulant use was also standardized post caremap implementation. More patients in the control cohort did not get anticoagulant use compared to the caremap cohort. Heparin was used in over 90% of patients in both cohorts (See Table 5.2.6). Enoxoparin use increased while Coumadin use decreased between the two cohorts.

5.2.2.2. *Differences in Timing of Interventions*

Time to surgical fixation did not differ between the two cohorts. The mean time to surgery following admission was within one day of admission for both groups, but the variation in practice was reduced in the Caremap cohort (See Table 5.2.6).

Time to initial postoperative rehabilitation was significantly reduced in the caremap cohort with rehabilitation starting on average, a half-day sooner post caremap implementation with less variation in practice (See Table 5.2.6).

A trend was noted for reduced indwelling catheter duration in the Caremap cohort by approximately a half-day, with less variation in practice (See Table 5.2.6).

Table 5.2.1. Demographics Obtained from Chart Review of All Patients Sustaining a Hip Fracture between July 1996 and September 1997 (Control) and July 1999 and September 2000 (Caremap)

Variable	**Control** (N = 678)	**Caremap** (N = 663)	**P-Value**
Mean Age (SD)	82.0 (7.8)	82.4 (7.9)	0.31 [a]
Gender (%)			0.57 [b]
Female	502 (74)	500 (75)	
Male	176 (26)	163 (25)	
Charlson Comorbid Index (%)			0.09 [b]
None	180 (27)	140 (21)	
Mild (1-2 Conditions)	317 (47)	329 (50)	
Moderate (3-4 Conditions)	133 (19)	151 (23)	
Severe (≥ 5 Conditions)	48 (7)	43 (6)	
Fracture Type (%)			0.08 [b]
FN	351 (52)	345(52)	
IT	327 (48)	318 (48)	
ST			
Admitted From (%)			0.29 [b]
Community	391 (58)	390 (59)	
Lodge	98 (14)	77 (12)	
Institution	189 (28)	196 (29)	
Medical Conditions on Admission			
Dementia	183 (27)	215 (32)	0.03 [b]
Cardiac Arrhythmias	98 (15)	138 (21)	0.003 [b]
Congestive Heart Failure	96 (14)	127 (19)	0.015 [b]

[a] Two Sample Independent T-test
[b] Chi Square test
LEGEND: SD = Standard Deviation; FN= Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 5.2.2. Comparison of In-Hospital Morbidity Between the Two Study Time Periods through Examination of Complications Occurring after Hospital Admission

Variable	**Control** (N = 678)	**Caremap** (N = 663)	**P-Value**
ICU Admission (%)	20 (3)	9 (1.4)	0.06 [a]
Congestive Heart Failure (%)	37 (6)	9 (1)	<0.001 [b]
Cardiac arrhythmia's (%)	36 (5)	8 (1)	<0.001 [b]
Pulmonary Edema (%)	45 (7)	23 (3.5)	0.08 [b]
Cognition (%)			<0.001 [b]
<22 MMSE score	290 (62)	189 (42)	
≥ 22 MMSE Score	178 (38)	262 (58)	
Pressure Ulcers (%)	15 (2)	3 (0.5)	0.007 [b]
Urinary Tract Infections (%)	144 (21)	120 (18)	0.15 [b]
Electrolyte Imbalances (%)	25 (4)	14 (2)	0.1 [b]
Postoperative Angina (%)	15 (2)	6 (1)	0.08 [b]
GI Bleed (%)	10 (1)	4 (0.6)	0.18 [b]
Respiratory Complications (%)	17 (3)	8 (1)	0.11 [b]
Pneumonia (%)	53 (8)	58 (9)	0.55 [b]
Postoperative Stroke (%)	9 (1)	8 (1)	1.00 [b]
Pulmonary Embolus (%)	5 (1)	6 (1)	0.77 [b]
Myocardial Infarction (%)	16 (2)	13 (2)	0.71 [b]

[a] Two Sample Independent T-test
[b] Chi Square test
LEGEND: MMSE = Mini Mental Status Examination

Table 5.2.3. Bivariate Analysis of Predictors of In-Hospital Mortality For All Hip Fracture Patients Examining Each Cohort Separately

	Control			**Caremap**		
Variable	OR	95% CI	P-Value	OR	95% CI	P-Value
Age (per Year increase)	1.06	1.02, 1.1	0.002	1.07	1.03, 1.12	0.001
Gender (Female = 0)	2.9	1.6, 5.2	< 0.001	2.6	1.4, 4.7	0.002
Charlson Comorbidity:			0.06			0.001
*None**	1.0			1.0		
Mild	1.3	0.60, 3.0	0.47	3.3	0.96, 11.1	0.06
Moderate	2.4	1.02, 5.7	0.04	4.7	1.3, 16.6	0.02
Severe	4.7	1.1, 9.2	0.03	12.1	3.1, 47.1	< 0.001
Admitted From:			0.016			0.29
*Community**	1.0			1.0		
Lodge	0.44	0.13, 1.5	0.19	1.6	0.85, 3.1	0.14
Institution	1.9	1.1, 3.5	0.03	1.6	0.66, 3.9	0.30
Preop Cardiac Disease (No=0)	2.8	1.5, 5.1	0.001	1.8	0.98, 3.2	0.06
Preop Arrhythmias (No=0)	1.7	0.8, 3.4	0.16	2.0	1.1, 3.8	0.03
Preop Aortic Stenosis (No=0)	2.7	0.58, 13.	0.21	2.93	0.61, 13.9	0.18
Preop CHF (No=0)	3.0	1.6, 5.7	0.001	2.9	1.5, 5.2	0.001
MI within 3-mths of Fracture (No=0)	0^+	No Deaths		6.6	1.2, 37.2	0.03
Preop Pulmonary Edema (No=0)	6.3	1.5, 26.1	0.01	6.6	1.2, 37.2	0.03
Preop Pneumonia (No=0)	3.4	0.92, 12.7	0.07	3.1	0.84, 11.2	0.09
Preop Respiratory Disease (No=0)	1.6	0.8, 2.9	0.12	2.8	1.6, 5.1	0.001
Pre fracture Dementia (No=0)	1.9	1.1, 3.5	0.03	1.2	0.62, 2.1	0.65
Diabetes (No=0)	2.0	1.0, 4.0	0.05	1.1	0.50, 2.4	0.82
Preop Malnutrition (No=0)	4.1	2.0, 8.3	< 0.001	3.1	1.13, 8.7	0.03
Preop Anemia (No=0)	1.9	0.90, 4.2	0.09	2.0	0.94, 4.4	0.07
Preop Renal Failure (No=0)	3.5	1.7, 7.2	0.001	4.3	2.2, 8.5	< 0.001
Preop Electrolyte Imbalance (No=0)	2.6	0.9, 7.0	0.07	0^+	No Deaths	
Immuno-suppressed Preop (No=0)	3.0	0.3, 27.8	0.32	11.1	2.9, 42.8	< 0.001
Type of Anaesthetic:			0.17			0.75
*Spinal**	1.0			1.0		
General	0.67	0.31, 1.5	0.13	1.3	0.63, 2.5	0.79
Combined	2.7	0.74, 9.8	0.33	0.79	0.74, 9.8	0.51

	Control			**Caremap**		
Variable	OR	95% CI	P-Value	OR	95% CI	P-Value
Postop ICU Admission (No=0)	11.7	4.6, 29.8	< 0.001	17.8	4.6, 68.6	< 0.001
Postop Stroke (No=0)	10.4	2.7, 39.8	0.001	8.1	1.9, 35.1	0.005
Postop Myocardial Infarct (No=0)	5.9	2.0, 17.8	0.001	17.3	5.6, 63.9	< 0.001
Postop CHF (No=0)	6.2	2.9, 13.4	< 0.001	6.8	1.6, 28.0	0.008
Postop Pulmonary Edema (No=0)	4.7	2.2, 9.9	< 0.001	3.9	1.4, 10.9	0.01
Postop Pneumonia (No=0)	11.2	5.8, 21.7	< 0.001	6.8	3.5, 13.4	< 0.001
Postop Respiratory Problems (No=0)	5.4	1.8, 16.1	0.002	8.1	1.9, 35.1	0.005
Postop Sepsis (No=0)	25.0	2.2, 280.5	0.009	0^+	**All Died**	
Postop Renal Failure (No=0)	13.8	4.6, 40.9	< 0.001	21.8	5.9, 80.3	< 0.001
Postop GI Bleed (No=0)	13.2	3.7, 47.3	< 0.001	0^+	No Deaths	
Postop Anemia (No=0)	1.7	0.95, 3.0	0.08	0.95	0.51, 1.8	0.87
Number of Complications (>2 =0)	3.4	1.8, 6.1	< 0.001	5.8	3.1, 10.9	< 0.001

* Reference Category; + Complete Separation

LEGEND: OR=Odds Ratio; CI= Confidence Intervals; CHF = Congestive Heart Failure; ICU = Intensive Care Unit; GI = Gastrointestinal

Table 5.2.4. Predictors of In-Hospital Mortality: Multivariate Analysis

Variable	OR	95% CI	P-Value
Group (Caremap = 0)	1.0	0.61, 1.7	0.96
Age (per unit increase)	1.1	1.07, 1.14	< 0.001
Gender (Female = 0)	2.8	1.6, 4.7	< 0.001
Preop Cardiac Disease (No=0)	1.8	1.04, 3.0	0.04
Preop Malnutrition (No=0)	2.0	0.92, 4.2	0.08
Preop Renal Failure (No=0)	2.2	1.2, 4.3	0.02
Postop ICU Admission (No=0)	10.3	3.6, 30.0	< 0.001
Postop Stroke (No=0)	6.2	1.5, 25.1	0.01
Postop Myocardial Infarct (No=0)	6.1	2.4, 16.0	< 0.001
Postop GI Bleed (No=0)	5.3	1.04, 26.7	0.04
Postop Pneumonia (No=0)	4.7	2.6, 8.6	< 0.001
Postop Respiratory Problems (No=0)	6.7	2.3, 19.5	< 0.001
Postop Renal Failure (No=0)	3.3	1.1, 10.1	0.03
Postop Sepsis (No=0)	85.7	8.4, 869.9	< 0.001

* Reference Category

Homer & Lemeshow Goodness of Fit : 0.33

LEGEND: OR=Odds Ratio; CI= Confidence Intervals; ICU = Intensive Care Unit; GI = Gastrointestinal

Table 5.2.5. Comparison of Health Service Utilization Between the Two Study Time Periods

Variable	**Control (N = 678)**	**Caremap (N = 663)**	**P-Value**
Mean Length of Stay in Days (SD)	11.4 (9.9)	13.6 (10.8)	<0.001 [a]
Median Length of Stay in Days	8	10	NA
Discharge Location (%)			<0.01 [b]
Home	26 (4)	51 (8)	
Rehab	432 (69)	377 (61)	
Lodge	2 (<1)	4 (1)	
Institution	166 (27)	183 (30)	
Readmissions in 6 months (%)	81 (12)	55 (8)	0.03 [b]

± Excludes Deceased in Hospital

[a] Mann Whitney U Test

[b] Chi Square test

LEGEND: SD = Standard Deviation

Table 5.2.6. Differences in Service Delivery Between the Two Study Time periods

Variable		Control (N = 678)	Caremap (N = 663)	P-Value
Narcotic Total (%)				<0.001 [b]
	Zero	7 (1)	5 (.6)	
	One	141 (21)	455 (69)	
	Two	369 (54)	167 (25)	
	Three	151 (22)	33 (5)	
	Four	10 (2)	3 (.4)	
Morphine (%)		636 (94)	643 (97)	0.01 [b]
Codeine (%)		474 (70)	144 (22)	<0.001 [b]
Demerol (%)		170 (25)	27 (4)	<0.001 [b]
Laxative Total (%)				<0.001 [b]
	Zero	78 (12)	48 (7)	
	One	54 (8)	395 (60)	
	Two	356 (52)	179 (27)	
	Three	150 (22)	32 (5)	
	Four	31 (5)	7 (1)	
	Five	9 (1)	2 (<1)	
Anticoagulant Total (%)				0.002 [b]
	Zero	36(5)	18 (2.7)	
	One	495 (73)	514 (77)	
	Two	146 (22)	122 (18)	
	Three	1 (<1)	9 (1)	
Enoxoparin Use (%)		5 (1)	32 (5)	<0.001 [b]
Coumadin Use (%)		158 (23)	90 (14)	<0.001 [b]
Time to Surgical Fixation in Days (SD)		1.19 (2.6)	1.17 (1.4)	0.10 [a]
Time to Rehabilitation Postop in Days (SD)		3.3 (2.8)	2.6 (1.7)	<0.001 [a]
Time with Indwelling Catheter in Days (SD)		6.6 (6.5)	6.0 (5.9)	<0.07 [a]

[a] Two-Sample Independent T-test

[b] Chi Square test

6. DISCUSSION

6.1. *Summary of Findings*

Use of standardized care through a caremap for elderly patients with hip fractures resulted in the following:

- Patients who did not have good social contacts achieved significantly better functional recovery within three months of fracture.
- Patients with poor social contacts were less likely to institutionalized by six months following their hip fracture.
- No difference in HRQoL in the initial six-months following hip fracture between the cohorts.
- Postoperative complications were reduced and ICU admissions halved.
- No difference in In-hospital mortality.
- Acute care LOS increased, but significantly more patients were discharged directly home rather than for further rehabilitation
- Re-admissions over the initial six-months following fracture were significantly reduced.
- Improved processes of care, with medication regimes becoming standardized and treatment more streamlined with less variation in timing of interventions.

6.1.1. Functional Recovery

One of the primary objectives of our study was to determine how functional recovery following hip fracture was affected by implementation of standardized evidence-based perioperative care. Through unadjusted analyses, we determined functional status was similar between cohorts prior to fracture, significantly higher six days postoperatively in the Control group, non-significantly higher in the Caremap group at three months and similar between the groups at six months following fracture.

The lower functional status seen at the initial postoperative assessment may be related to poorer pain control due to changes in the analgesic regimen associated with the caremap. In the Control cohort, patients commonly received multiple opioid medications such as Codeine and Morphine, for pain relief. In the Caremap cohort, most patients received only Morphine, as part of the delirium protocol designed to reduce delirium and adverse effects of other narcotics.

Although much is known about the effects of under-treatment of pain in younger patients, very few studies have examined how management of pain affects recovery in older adults.[201] Morrison et al. (2003) reported inadequate analgesia delayed early mobilization in their study of a cohort of elderly patients with hip fracture.[202] The analgesic regimen currently implemented with the caremap requires further examination to determine if inadequate analgesia is adversely affecting early recovery.

In the sub-group analyses of patients with and without dementia, there were no statistically significant differences between cohorts in improvement of function over the six-month postoperative period, although in patients without dementia, there was a trend to better function in the Caremap cohort.

Although unadjusted analyses showed similar function between groups at three and six months post fracture, risk-adjustment of functional recovery at three months revealed some important differences between groups. The three-month assessment was used for the risk adjustment assessment because the majority of functional recovery had occurred in both groups by that time. We found patients who had good social contact in either group were predicted to have reasonably good three-month function, as were patients who had poor social contacts in the Caremap cohort. In contrast, patients in the Control group who had poor social contacts were predicted to have a significantly lower level of function at the three-month assessment.

Social support, measured as the amount of contact that patients have with others outside their home, has not commonly been evaluated as a predictor of functional recovery. The limited research using social support as a predictor reported findings similar to that of the Control cohort - patients with poor social support showed slower return of functional status post hip fracture.[131,140]

We hypothesize that the improvements in functional recovery occurring in the Caremap group with poor social contacts were due to standardized discharge planning, one of the components of the caremap. Implementing coordinated discharge planning to determine patients' post-hospital placement and care reduced the need for patients to rely on social contacts to ensure they would receive appropriate rehabilitation opportunities following their fracture. This planning process for patient post discharge needs is, however, difficult to quantify and was not formally measured as part of the study outcomes. Thus, further work is required to determine if our hypothesis is correct.

We found functional recovery was positively affected by standardized care in the early postoperative period for a sub-set of patients only, those with poor social contacts. Cameron et al. (2001) in a CSR of the effect of standardized multi-disciplinary in-patient rehabilitation following hip fracture reported the effects of such programs on functional recovery were inconclusive.[20] In the five studies that used an objective function assessment, only two showed a positive effect on functional recovery, while the others demonstrated no differences between groups. Future research examining standardized care should pay careful attention to patients at high risk of lower levels of recovery to determine the effect of standardized programs on these sub-groups.

6.1.2. Health Related Quality of Life

In this study, HRQoL was similar between the groups in both unadjusted and risk-adjusted analyses of MHC and PHC scores. HRQoL has not been frequently measured in this patient population and has, thus far, been limited to community-dwelling subjects without cognitive impairment.[115-117] Even in these patients, who would be expected to make the best recovery, all of the studies reported patients had lower levels of HRQoL up to one year following fracture compared to pre fracture.

We measured HRQoL in both community and nursing home-dwelling patients with and without cognitive impairment. Our study found MHC and PHC scores were lower than pre fracture scores at the three and six-month assessments in both Caremap and Control cohorts, similar to findings of previous research. Risk adjustment did not reveal any differences between the groups or identify significant modifiable predictors that could be used to improve HRQoL in the elderly hip fracture population. In fact, the final models in our study did not predict a large part of the variance, suggesting that we did not measure important factors that determine HRQoL.

Although we attempted to measure HRQoL in subjects with cognitive impairment, using a proxy respondent was associated with a poor three-month MHC score. Previous research has shown only fair agreement between patient and proxy respondents with proxies overestimating impairment and underestimating HRQoL compared to patient respondents.[178-180] The MHC score, which involves rating non-observable feelings, is considered to be more at risk than the PHC score, which examines observable behaviors. We used proxy respondents for patients with MMSE scores less than 22; patients who likely would have lower HRQoL. We are, however, unable to discriminate between the reduction in mental health that reflects a true reduction in HRQoL and that which represents the influence of using a proxy respondent. Assessment of HRQoL in cognitively impaired patients presents a conundrum for researchers. At the present time, the only way of measuring HRQoL in these subjects is through use of proxy respondents. Further research is required to determine the usefulness of HRQoL assessment in cognitively impaired subjects.

6.1.3. Institutionalization

Institutionalization at six months was not significantly different between cohorts nor was the rate of institutionalization reported in our study different from that reported in previous studies of the hip fracture population.[19,129,191]

We did, however, identify a pattern of reduced institutionalization for patients with poor social contacts in the Caremap compared to the Control group, as seen with functional recovery. Patients who had poor social contact in the Control cohort were approximately three times as likely to be institutionalized compared to patients with good social contacts. In the Caremap cohort, patients with poor social contact were only 40% more likely to be institutionalized compared with those who had good social contact.

Loss of independence, requiring a change in living arrangements, is one of the more significant negative outcomes that elderly subjects associate with a hip fracture.[9] Further, the costs associated with ensuing institutional care make up a significant part of costs arising from the treatment of hip fracture,[5] so any reductions realized in institutionalization has positive ramifications from "patient" "health-care provider" and "societal" viewpoints.

Aside from this sub-group of patients who were associated with reduced institutionalization, our results concur with that of previous research; patients with cognitive impairment, who are more dependent in ADL prior to fracture are at increased risk of institutionalization following a hip fracture.

6.1.4. Morbidity

Assessment of morbidity was undertaken in all eligible patients who had a hip fracture within the two study intervals, not only in the patients who agreed to be in the follow-up cohort. Inclusion of all patients allowed us to measure the effect of the caremap on subjects who were too ill to be in the follow-up study, making the results generalizable to the entire hip fracture population, rather than the healthiest sub-set frequently involved in studies of hip fracture outcomes.[2,8,40,62,74,89,115,118,122,129,147,151,157,185]

Postoperative morbidity in the hospital was reduced in the Caremap cohort as measured by the frequency of complications postoperatively. More patients were diagnosed with cardiac conditions preoperatively in the Caremap cohort, but postoperative cardiac complications were markedly reduced in this group relative to the Control group. These findings would suggest one of two possibilities. The Caremap cohort was, on the whole, less healthy on admission and standardized care reduced their postoperative complications to a level lower than that experienced by the Control cohort, or patients in each group had similar levels of comorbidity, but standardized care lead to patients receiving improved preoperative evaluation, thus identifying more comorbidities, and preventing development of postoperative complications. Either of these scenarios supports the effectiveness of standardized care in reducing morbidity post surgery.

In addition to the reduction of major cardiac complications, development of pressure ulcers was also significantly reduced, supporting the preventative assessment strategy implemented in the Caremap. In fact, the only complication that increased in frequency was the number of patients who experienced septic shock postoperatively. Six patients in the Caremap cohort compared with three of the Control cohort developed septic shock with eight of the nine patients dying as a result of this complication (all of the Caremap and two of the Control cohort patients). There is no clear reason for the increase in septic shock although there were a non-significantly higher number of patients admitted with opportunistic infections at the time of fracture in the Caremap cohort.

Reducing major complications halved the ICU admissions in the Caremap compared to the Control cohort, ($p = 0.06$), and although this did not reach our predetermined level of statistical significance, ($p = 0.05$), the cost ramifications associated with this difference in outcomes is likely important to health care providers.

Finally, more patients in the Control cohort scored lower than 22 on the MMSE compared to the Caremap group in the first week following surgery. We hypothesize that the change in the narcotic medication regimen between groups may account for the findings of improved postoperative cognition for the Caremap group. Opioid use, particularly the use of Meperidine, in the elderly is associated with increased delirium,[199,203] and significantly fewer patients in the Caremap cohort were exposed to Meperidine compared to the Control cohort. Unfortunately, the instrument chosen to evaluate cognition does not differentiate between acute delirium and chronic dementia,[162] so we were unable to distinguish whether the lower mental status measured postoperatively in the Control group was a temporary postoperative complication or a more long-standing problem.

6.1.5. Mortality

Despite reductions in number and type of postoperative complications, there was no difference in in-hospital mortality between the two cohorts. The complications associated with mortality in hospital were for the most part, catastrophic events such GI bleeds, stroke and myocardial infarct, all of which occurred infrequently in both cohorts. Although ICU admission decreased more than 50% in the Caremap cohort, sepsis doubled in this group, so that the overall effect on mortality was negligible. All other significant predictors of mortality were not different between the two cohorts. Pre-existing conditions, especially cardiac conditions were associated with increased mortality risk, and although standardized care led to increased diagnoses of comorbidities, most were non-modifiable, so identification only alerted the medical staff to the increased mortality risk. Our findings are similar to the findings of previous studies,[20,191] which reported no difference in mortality following implementation of multi-disciplinary care in this patient group.

6.1.6. Health Service Utilization

One of the most disappointing findings of the comparison of the two cohorts was that the acute care LOS increased by an average of two days in the Caremap cohort. One of the explicit objectives of the caremap implementation was to shorten hospital stay through standardized medical care and early rehabilitation in addition to coordinated early discharge planning. However, LOS is a composite variable that is affected not only by the patients' capacity to be discharged, but also by having an appropriate discharge location. The CH region frequently uses inpatient sub-acute rehabilitation offered at sites other than the surgical hospital. Because of the number of patients seen each year for treatment of a hip fracture in CH, bed accessibility in the sub-acute facilities is a consistent problem. Further, patients who are admitted from the community, but who require a higher level of care post fracture wait in the acute care hospital for a bed to become available in a LTC facility. With an aging population, it is possible that in the interim between studies, bed access to these facilities was reduced due to increased demand. Because we measured only how long the patient remained in hospital and not when they were ready for discharge, we may not have an accurate representation of why LOS increased between cohorts.

In counterpoint to the increased LOS in the acute care hospital, patients in the Caremap cohort were significantly more likely to be discharged home rather than to a rehabilitation facility, and re-admissions over the six-month follow-up period were reduced to 55 (8%) from 81 (12%) following caremap implementation. Further data are required to quantify total days in hospital including the LOS in the rehabilitation facility and during the re-admission.

6.1.7. Evaluation of Care Delivery

In contrast to previous studies of standardized care, we also assessed how care delivery differed with the use of a caremap. As usual care prior to the caremap was already multidisciplinary, it was important to determine if medical and rehabilitation care was delivered differently following implementation of standardized care.

Assessment of timing of specific interventions between the control and caremap cohort demonstrated significant reductions in the average time to rehabilitation postoperatively and use of indwelling catheterization in the Caremap cohort. Further, variation in practice was also reduced, indicating that care had become more streamlined with the caremap in place. Medication regimens also showed significant differences with routines becoming more standardized, with less use of multiple medications for analgesia, bowel routines and DVT prophylaxis.

6.2. Strengths of the Study

Elderly patients are at significant risk for increased functional dependence, morbidity, institutionalization and mortality following a hip fracture.[2,8,89,119,132,133,147] One approach to facilitate optimal patient recovery is standardized treatment plans based upon current "best evidence". This study involved two independent prospective population-based cohorts, including patients from both community and institutional settings, increasing the generalizability of our study. Frequently, studies of functional recovery following hip fracture include only community-dwelling subjects, eliminating a significant proportion of the geriatric hip fracture population, and including only the "best" set of this frail population. Our goal was to determine if applying standardized care to the entire hip fracture population afforded better patient outcomes and optimized health service utilization in all patients including frail patients living in institutional settings.

Data collection was prospective in both study groups despite using a historical control group. Our study took advantage of a previous study that examined outcomes following a hip fracture using usual care. Following data collection for the initial cohort, a caremap was put in place and utilized for 15 months prior to commencement of the second part of the study. The interim allowed clinical staff to familiarize themselves with the caremap and to revise any portions not conducive to clinical care. In both cohorts, standardized data collection was undertaken by examiners not involved in patients' treatment or in direct management of the wards or hospitals reducing the bias that might have been associated with an internal evaluation of caremap implementation.

To further ensure that the groups were comparable, the same instruments were utilized in the caremap as were used in the control study. Data collection staff were trained to utilize the measures with the same guidelines as the control cohort and used identical data collection forms.

Several different patient outcomes were evaluated including functional recovery, HRQoL, morbidity, mortality and health service utilization. Patient interviews were undertaken with the majority of patients using validated measures of function and HRQoL.

6.3. Limitations of the Study

The use of a pre/post research design rather than a randomized clinical trial is the most significant limitation of the study. Without randomization, we cannot be sure that we controlled for all important factors between the cohorts. A randomized controlled trial would have been difficult after regional caremap implementation due to concerns with contamination and co-intervention between treatment and control groups. We did, however take several steps to ensure that the groups were similar except for the intervention being studied in order to link differences in outcomes to the intervention, as described in the previous section.

Unfortunately, some outcomes were not evaluated with the most responsive outcome measures available. As an example, the BFI has only three categories, "independent", "needs assistance" or "unable". Patients in the middle category represent diversity in function, as we cannot distinguish between standby, minimal, moderate or maximal assistance. Additionally, cognition was measured only at the immediate-postoperative interval, so we were unable to discern if measurable differences in cognition between cohorts were due to different prevalence rates of dementia or different incident rates of delirium.

Losses to follow-up were systematically different between groups with the patients who were lost to follow-up at six-months in the Caremap cohort and at three-months in the Control cohort having significantly higher baseline functional levels than patients who continued in the study. However, the number of patients lost to follow-up was very small in both groups, and likely did not have a significant effect on reported function.

We attempted to include all patients who fractured their hip from all settings, but we did exclude the large rural population that CH serves. The reason for their exclusion was that long distance follow-up telephone interviews were beyond the budget of the study. Thus, our results may not be generalizable to individuals residing in rural regions.

Non-respondents from both groups were systematically different from the respondents. In general, non-respondents were sicker, older and more likely to come from institutional settings. Although proxy respondents were approached for all medically stable subjects, the refusal rate was higher for these individuals as proxies could not see the applicability of our interview to their elderly relatives, who frequently had dementia and very limited functional capacity.

Assessment of LOS was limited to the surgical hospital as the LOS in the sub-acute rehabilitation facilities was not available for evaluation. With more patients being discharged directly home in the caremap cohort in addition to the reduced re-admission rate, the overall LOS in hospital during the initial six-months postoperatively may well be less in the caremap cohort.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusion

The findings of our study add to the body of evidence regarding how elderly patients with hip fracture should be managed in the early postoperative period. Our results can be considered generalizable to urban populations of elderly hip fracture patients, including both community and institutionally based individuals.

Overall, the caremap did not affect functional recovery, HRQoL or the institutionalization rate during the first six months following a hip fracture. However, the use of a caremap was beneficial for a sub-group of patients, those with poor social contacts, allowing this group to attain functional results similar to those with good social contacts in either cohort and reducing their rate of institutionalization. Further, use of a caremap reduced the postoperative morbidity associated with a hip fracture.

Thus, use of a caremap for treatment of elderly patients following a hip fracture is beneficial, as it allowed individuals at risk for poor outcomes to improve their level of recovery and did not lead any increase in adverse events.

7.2. Recommendations

7.2.1. For Practice

- Assessment of pain management during the perioperative period should be undertaken to determine if adequate analgesia is being offered with the current regimen.

- Further standardization of care for patients as they continue to progress through the recovery continuum should be implemented and evaluated. If early rehabilitation and standardized care can impact the rate and extent to which patients recover, perhaps further improvements in outcome can be expected if we apply similar principles to sub-acute recovery settings. Coordination of the patients' care as they move through different settings and disciplines will encourage better communication within and across disciplines and settings. Improvement in communication may lead better management of conditions such as malnutrition, predilection to falls, or osteoporosis, factors that cannot be altered during the acute peri-operative time period. Future research should determine how to best deliver care following the acute perioperative period.

7.2.2. For Research

- Outcome measures should be considered carefully in future studies to ensure that the most responsive tool is utilized. In addition, re-assessment of cognition would have also added value to the findings and should be considered in studies where an intervention that affects cognition (through delirium) has occurred (i.e. hip fracture, exposure to anaesthetic).

- Timing of postoperative assessments may also affect the ability to detect differences in outcomes between groups. By three-months post fracture, most patients had completed the majority of their functional recovery. Assessments at one or two months following fracture may allow better examination of rate of functional recovery.

- Subjects from rural regions should be included in future research to determine if their outcomes are similar to their urban counterparts.

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9. APPENDICES

9.1. Search strategies

Medline 1966 to August 2003 Search History		Results
1	exp Hip fractures/	8863
2	"fractured neck of femur".mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	180
3	((hip or femoral neck or intertrochanteric or pertrochanteric or subtrochanteric) adj fracture$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	5739
4	1 or 2 or 3	10260
5	exp Age factors/	235821
6	exp Health status/	32764
7	(health$ or geriatric assessment or nutritional status).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	732000
8	Risk/ or Risk assessment/ or Risk factors/	270236
9	Comorbidity/	11933
10	exp Postoperative complications/	238136
11	(comorbid$ or complicat$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	317984
12	5 or 6 or 7 or 8 or 9 or 10 or 11	1587325
13	exp fracture fixation/ or "fracture fixation".mp.	27304
14	exp Rehabilitation/	125871
15	rh.fs.	86210
16	rehabilitat$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	53690
17	acute management.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	447
18	(home$ adj assist$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	115
19	exp Patient care management/	224858
20	((critical or clinical) adj path$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	13774
21	(care map$ or care path$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	321
22	clinical management.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	6209
23	exp postoperative care/ or "post-operative care".mp.	34790
24	"POSTOPERATIVE CARE".mp.	35755
25	exp Patient care planning/	27180
26	patient care plan$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	22899
27	(aftercare or after care).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	299341
28	(aftercare or after care).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	33795
30	(hospital$) adj discharg$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	12024
31	Home care services/ or Home care services, hospital-based/ or Home nursing/ or Homemaker services/	23250
32	13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31	745952
33	exp length of stay/ or "length of stay".mp.	27684
34	(long term stay$ or longterm stay$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	76

35	exp range of motion, articular/ or "range of motion".mp.	12941
36	Locomotion/ or Walking/	13948
37	walk$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	24191
38	exp fracture healing/ or "fracture healing".mp.	4085
39	(fracture$ adj heal$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	2726
40	exp mortality/ or "mortality".mp.	255054
41	mo.fs.	201246
42	Morbidity/	13582
43	morbidity.mp.	91001
44	exp survival analysis/ or "survival analysis".mp.	41043
45	exp "Outcome and process assessment (health care)"/	161826
46	(function$ adj recover$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	5376
47	hospital discharge status.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	14
48	independen$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	260148
49	exp patient readmission/ or "patient readmission".mp.	3025
50	rehospitaliz$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	1161
51	exp quality of life/ or "quality of life".mp.	44976
52	outcome$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	235276
53	recover$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	206557
54	(functional adj (capacity or status)).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	9868
55	exp patient satisfaction/ or "patient satisfaction".mp.	19455
56	recur$.mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	216115
57	Recurrence/	88367
58	"MOBILITY".mp.	39944
59	33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58	1370358
60	"comparative study"/	982711
61	compar$.mp.	1973553
62	Cohort studies/ or Follow-up studies/ or Prospective studies/	400587
63	(cohort$ or follow-up or prospective$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	459190
64	Case-control studies/ or Retrospective studies/	206507
65	(case-control$ or retrospective$).mp. [mp=title, abstract, cas registry/ec number word, mesh subject heading]	242181
66	(controlled clinical trial$ or (random$ and trial$)).mp,pt.	140626
67	(control$ adj trial$).mp.	25784
68	random$.mp.	266947
69	60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68	2627208
70	4 and 12 and (32 or 59) and 69	

Essentially the same strategy was used with Healthstar and EMBASE (which now allows for cross referencing to MeSH headings).On Ageline, Sociofile, CINAHL, PEDRO, and the internet (via the Google search engine), a much simpler strategy was employed, searching by "Hip fracture[truncated]" and selecting manually from the results.

9.2. *Local Telephone Prefixes*

Phone Prefix	Location
363	Chipman
387	Millet
447	Winterburn
449	Sherwood Park
458	St. Albert
459	St. Albert
460	St. Albert
464	Sherwood Park
467	Sherwood Park
470	St. Albert
662	Tofield
789	Thorsby
796	Bruderheim
878	Hay Lakes
892	Wabumum
895	Lamont
921	Bon Accord
922	Ardrossan
923	Gibbons
924	Alberta Beach
939	Morinville
941	New Sarepta
942	Redwater
955	Nisku
962	Spruce Grove
963	Stony Plain
967	Onoway
973	Namao
985	Calmar
986	Leduc
987	Devon
992	Fort Saskatchewan
998	Fort Saskatchewan

9.3. Informed Consent and Instruments

INFORMATION SHEET FOR PATIENTS
Effectiveness of a Caremap for Hip Fractures

Principal Investigators: Dr. DWC Johnston Dr. JG Cinats
Co-Investigators: LA Beaupre A Scharfenberger CA Jones D Lier
ME Suarez-Almazor E Seib D Williams

Background: Patients with hip fracture are at increased risk for prolonged disability and may need long-term care. Previous studies have suggested that early mobilization and changing pain medication may lead to a better outcome following a hip fracture. A caremap that consists of treatment guidelines ensuring that all patients with a hip fracture receive similar treatment during their hospital stay, has been developed for the Capital Health Authority to try and improve the outcome for these patients.

Purpose: You are being asked to participate in this research study because you have broken your hip. The purpose of this study is to determine whether the use of a caremap improves your hospital stay and how you manage after you are discharged from the hospital.

Procedures: Participating in this study will involve three assessments: today and at 3, and 6 months following your fracture. At these times you will be required to complete questionnaires regarding your health and your hip fracture, and how they interfere with your daily activities and your quality of life. The first assessment will take 30-40 minutes. The follow-up questionnaires can be completed over the phone and should take approximately 20-30 minutes. Personal interviews may be scheduled at your residence if this is your preference.

Possible Benefits: There may not be direct benefits to you for participating in this study. However, it is expected that once the study is complete, the results will help professional caregivers provide best care for hip fracture patients.

Possible Risks: There are no risks involved in this study.

Confidentiality: Personal records relating to the study will be kept confidential. Any report published as a result of this study will not identify you by name.

You are free to withdraw from the research study at any time and your continuing medical care will not be affected in any way. If the study is discontinued at any time, the quality of your medical care will not be affected.

Please contact any of the individuals below if you have any questions or concerns.

Lauren Beaupre, M Sc (PT)	407 -3945
Dr. DWC Johnston, MD, FRCS (C)/Dr. JG Cinats, MD, FRCS (C)	407-8822

If you have further concerns about any aspects of this study, you may contact the Patient Concerns office of the Capital Health Authority at 407-9790. This office has no affiliation with the study investigators.

Title of Project:	**Effectiveness of a Hip Fracture Caremap**

Principal Investigator(s):	**DWC Johnston, MD 439-4945**	**JG Cinats, MD**	**439-8939**
Co-Investigator(s):	**Lauren Beaupre, M Sc (PT)**	**407-3945**	
	M Suarez-Almazor, MD, PhD E Seib, RN	CA Jones, M Sc, PhD D Williams, RN	D Lier, B Sc A Scharfenberger, MD

Part 2 (to be completed by the RESEARCH SUBJECT):

Do you understand that you have been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Sheet?	Yes	No
Do you understand the benefits and risks involved in taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your care.	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to your records?	Yes	No

This study was explained to me by: ______________________________

I agree to take part in this study.

______________________________ ________________ ________________
Signature of Research Participant Date Witness

______________________________ ________________
Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

______________________________ ________________
Signature of Investigator or Designee Date

INFORMATION SHEET FOR CARE-GIVERS
Effectiveness of a Caremap for Hip Fractures

Principal Investigators:	Dr. DWC Johnston	Dr. JG Cinats	
Co-Investigators:	LA Beaupre	A Scharfenberger	CA Jones
	D Lier	ME Suarez-Almazor E Seib	D Williams

Background: Patients with hip fracture are at increased risk for prolonged disability and may need long-term care. Previous studies have suggested that early mobilization and changing the type of pain medication may lead to a better outcome following a hip fracture. A patient caremap has been developed for the Capital Health Authority following these findings to try and improve the outcome for hip fracture patients. A caremap consists of treatment guidelines that ensure all patients with a hip fracture receive similar treatment during their hospital stay.

Purpose: You are being asked to give us permission to include this patient in this research study. The purpose of this study is to determine whether the use of a caremap, to standardize care during a patient's hospital stay, improves the outcome of these patients after a hip fracture.

Procedures: Participating in this study will involve three assessments: today and at 3, and 6 months following the hip fracture. At these times, the patient or caregiver will be required to complete questionnaires regarding health and the hip fracture, and how they interfere with daily activities and quality of life. The first assessment will take 30-40 minutes. The follow-up questionnaires can be completed over the phone and should take approximately 20-30 minutes. Personal interviews may be scheduled at your residence if this is your preference.

Possible Benefits: There may not be direct benefits to the patient for participating in this study. However, it is expected that once the study is complete, the results will help professional caregivers provide the best care for hip fracture patients.

Possible Risks: There are no risks involved in this study.

Confidentiality: Personal records relating to the study will be kept confidential. Any report published as a result of this study will not identify the patient by name.

The patient is free to withdraw from the research study at any time and his/her continuing medical care will not be affected in any way. If the study is discontinued at any time, the quality of his/her medical care will not be affected.

Please contact any of the individuals below if you have any questions or concerns.

Lauren Beaupre, M Sc (PT)	407 -3945
Dr. DWC Johnston, MD, FRCS (C)/Dr. JG Cinats, MD, FRCS (C)	407-8822

If you have further concerns about any aspects of this study, you may contact the Patient Concerns office of the Capital Health Authority at 407-9790. This office has no affiliation with the study investigators.

Title of Project: **Effectiveness of a Hip Fracture Caremap**

Principal Investigator(s): **DWC Johnston, MD 439-4945** **JG Cinats, MD** **439-8939**
Co-Investigator(s): **Lauren Beaupre, MSc (PT)** **407-3945**

M Suarez-Almazor, MD, PhD CA Jones, MSc, PhD D Lier, BSc
E Seib, RN D Williams, RN A Scharfenberger, MD

Part 2 (to be completed by the NEXT-OF-KIN/CAREGIVER):

Do you understand that ________________ has been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Sheet?	Yes	No
Do you understand the benefits and risks involved for this patient taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you and/or the subjects are free to refuse to participate or withdraw from the study at any time? A reason is not required and it will not affect the patient's care.	Yes	No
Has the issue of confidentiality been explained to you? Do you understand who will have access to this patient's records?	Yes	No

This study was explained to me by: ____________________________

I agree to take part in this study.

____________________________ ____________ ____________________________
Signature of Research Participant Proxy Date Witness

____________________________ ____________________________
Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

____________________________ ____________________
Signature of Investigator or Designee Date

BASELINE DEMOGRAPHIC:

CASE #:______________________________0 RAH 1 UAH

INTERVIEWER____________________

Please insert RAH patient
ID sticker here

Address: ____________________________ City/town:
Postal Code: ____________________ Telephone Number:
Nursing Home:____

Marital Status: ☐ 1 Married ☐ 2 Single ☐ 3 Widowed ☐ 4 Divorced ☐ 5 Never Married

Gender: ☐ 0 Female ☐ 1 Male

Family Doctor________________________

PROXY INFORMATION (if a proxy is interviewed, please complete the following)

Name: ____

Address: ____ City/town: ___________________

Postal Code: ____________________ Telephone Number: _____________________

Relationship to Patient: ☐ 1 Spouse ☐ 3 Friend
☐ 2 Son/Daughter ☐ 4 Other (please specify):____________

CONTACT PERSON:(does not live with person):(relationship) _________________________________

Phone #:_________________

Address:____(City)______________________________

Date of Hip Fracture (dd/mmm/yy) ____________Which hip was fractured? ☐0 Left ☐1 Right ☐2

Both

Date of Admission (dd/mmm/yy) ______________________

Date of Surgery (dd/mmm/yy)_________________________

TYPE OF TRAUMA SUSTAINED

☐1 No trauma (sitting, sleeping, etc.)
☐2 Trauma - no fall (bumping into something, etc.)
☐3 Trauma - from fall (falling from standing, height, etc.)☐1. Inside ☐2. Outside ☐3. Not specified
☐4 Trauma - motor vehicle accident
☐ 5 Other (please specify)____________________________

MINI-MENTAL STATE

Date (dd/mmm/yyyy)______ ______

Interviewer__________________________

Patient ID Sticker

I. ORIENTATION (Maximum score 10)

What date is today? ________________ 1. ________
What year is this? ________________ 2. ________
What month is this? ________________ 3. ________
What day is this? ________________ 4. ________
What season is this? ________________ 5. ________
What hospital is this? ________________ 6. ________
What floor are we on? ________________ 7. ________
What town or city are we in?________________ 8. ________
What province are we in? ________________ 9. ________
What country are we in? ________________ 10. ________

II. REGISTRATION (Maximum score 3)

I am going to name three objects, BALL, FLAG, TREE - What were those objects? 11. ______ Ball
Repeat the words until the patient learns them 12. ______ Flag
(Up to six trials) Number of trials _______ 13. ______ Tree

III. ATTENTION AND CALCULATION (Maximum score 5)

Ask the subject to begin at 100 and count backward by seven. (If the subject will attempt even one subtraction, score the serial 7's in preference to the spelling task.) 93____ 86 ____ 79____ 72 ____ 65 ____

If the subject cannot or will not perform this task ask to spell the word "world" backward. The score is one point for each correctly placed letter. DLROW

14. __________
15. __________
16. __________
17. __________
18. __________

IV. RECALL (Maximum score 3)

What were those three objects I named a minute ago? (Do not give clues.)

19. __________
20. __________
21. __________

V. LANGUAGE (Maximum score 9)

a) Naming - What is this? (Point to a watch) 22. __________
What is this? (Point to a pencil) 23. __________

b) Repetition - "No ifs, ands, or buts" Repetition should be exactly correct. 24. __________

c) Three stage command - Please follow these instructions. (Give all three instructions together.) "Take the paper in your right hand; fold the paper in half; put the paper on the floor." Score 1 point for each part correctly done.

25. __________
26. __________
27. __________

d) Reading - Please read and do what the sign says. Show sign with "CLOSE YOUR EYES" Score correct only if patient actually close his/her eyes. 28. __________

e) Writing - Please write a sentence of your choice. Sentence must contain a subject and a verb. (Ignore spelling errors.) 29. __________

f) Copying - Please copy this design. (Give patient pentagon design -ensure 10 points, 2 of which overlapping.) 30. __________

COMMENTS: If patient is blind, score out of 27; If the patient cannot read or write, score out of 22.

TOTAL SCORE: ____________

IN-PERSON INTERVIEW FORM-BASELINE QUESTIONNAIRE

PATIENT____ CASE#-

____

INTERVIEWER________________________________Date____________________________

Do you NOW have any of the following conditions?

Blindness or trouble seeing, even when wearing glasses?	Yes 1	No 0	Unknown 9
Deafness or trouble hearing?	Yes 1	No 0	Unknown 9
Arthritis or rheumatism?	Yes 1	No 0	Unknown 9
Sciatica or chronic back problem?	Yes 1	No 0	Unknown 9

Other____________________________

This survey asks for your views about your health before you fractured your hip.

During the four weeks immediately prior to your hip fracture, what was your usual level of daily activity?

No activity/ bed-bound	1
Wheelchair	2
Walked with personal assistance	3
Walked with mechanical assistance	4
Walked without assistance	5
Walked a half mile or less outside the home each day	6
Walked vigorously or jogged more than half a mile each day	7

During the four weeks immediately prior to the fracture, how frequently did the hip that was fractured cause you difficulty with the following activities?

	Never	Rarely	Sometimes	Often	Always
Stooping or bending	1	2	3	4	5
Standing up from a chair	1	2	3	4	5
Sitting down in a chair	1	2	3	4	5
Climbing a flight of stairs	1	2	3	4	5
Walking while outdoors	1	2	3	4	5

During the four weeks immediately prior to the fracture, how much pain did you have in the hip that was fractured?

None	1	Moderate	4
Very mild	2	Severe	5
Mild	3	Very severe	6

RAND-12 HEALTH SURVEY

This survey asks for your views about your health before your hip fracture. This information will help keep track of how you feel and how well you are able to do your usual activities.

1. In general, would you say your health before the fracture was:

Excellent	Very Good	Good	Fair	Poor
1	2	3	4	5

The following items are about activities you might have done during a typical day before your fracture. Did your health before your fracture limit you in these activities? If so, how much?

	A Lot	A Little	None
2. Moderate Activities, such as moving a table or chair, vacuuming, lifting and carrying groceries	1	2	3
3. Climbing several flights of stairs	1	2	3

During the four weeks before your fracture, did your have any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
4. Accomplished less than you would like	1	0
5. Were limited in the kind of work or other activities	1	0

During the four weeks before your fracture, did you have any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
6. Accomplished less than you would like	1	0
7. Didn't do work or other activities as carefully as usual	1	0

8. **During the four weeks before your fracture, how much did pain interfere with your normal work (including work outside the home and housework)?**

Not at all	A little bit	Moderately	Quite a bit	Extremely
1	2	3	4	5

These questions are about how you felt and how things have been with you during the four weeks before your fracture. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the four weeks before your fracture:

	All	Most	Good Bit	Some	A Little	None
9. Have you felt calm and peaceful?	1	2	3	4	5	6
10. Did you have a lot of energy	1	2	3	4	5	6
11. Have you felt downhearted and blue?	1	2	3	4	5	6

12. During the four weeks before your fracture, how much of the time had your physical or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
1	2	3	4	5

13 How often in the past month have you had difficulty sleeping?

- ☐1 Not at all
- ☐2 1-3 nights per week
- ☐3 Most nights of the week
- ☐4 Nearly every night for at least 2 weeks

Barthel Functional Index

Now I would like to ask you about your functional activity before your hip fracture. If there was no one to help (him or her) with the following, could you do it alone? (If no, could you do it with assistance?)

Items	Unable to perform task	Needs assistance	Fully independent
Feeding*(includes cutting, spreading butter).*	0	5	10
Personal hygiene*(wash hands and face, shave, brush teeth).*	0	0	5
Bathing Self *(must be able to bath or shower without anyone present).*	0	0	5
Dressing* *(can put on shoes, socks, pants etc. without help).*	0	5	10
Toileting *(can remove clothes, wipe him/herself, get on and off toilet).*	0	5	10
Bowel control*(no accidents day or night).*	0	5	10
Bladder control*(controls bladder day and night).*	0	5	10
Chair/bed transfers*(can safely transfer from a chair to a bed and back again).*	0	5 10	15
Walking**(walks 50 yards without help or supervision but may use aids).*	0	10	15
Stair Climbing*(goes up and down stairs independently).*	0	5	10
Wheelchair***(maneuver corners, position himself near bed, toilet etc.).*	0	0	5

* If patient has special aids that he/she has to wear, he/she must be able to put them on by him/herself or he/she is classified as needing help.

** If the patient is independent with an aid, then patient is independent.

*** Score only if unable to walk.

Notes

- For bowel and bladder control, a patient needs assistance if they have occasional accidents (dribbling, night-time, etc.)
- For chair/bed transfer, a score of 10 is given if patient needs minimal assistance (stand-by) of one and a score of 5 is given for a patient that needs a maximal assistance of 1.

☐ 1 Nurse ☐ 3 Proxy

☐ 2 Physio ☐ 4 Patient

SOCIAL RESOURCES QUESTIONNAIRE

I would like to ask you some questions about your family and friends.

Are you single, married, never married, widowed, divorced or separated ?

☐1 Single (never married)
☐2 Married
☐3 Widowed
☐4 Divorced
☐5 Separated
☐6 Common law
☐9 Not answered

Who lives with you (you may circle more than one number for this question)

☐Home alone
☐Husband or wife
☐Nursing home/Auxiliary
☐Seniors Home/Apt
☐Parents
☐Grandparents
☐Children
☐Grandchildren
☐Home unspecified
☐Brothers and sisters
☐Friends
☐Other relatives (does not include in-laws covered in the above categories)
☐Non-related paid helper(includes free-room)
☐Other(specify):______________________________

How many people do you know well enough to visit in their homes?

☐3 Five or more
☐2 Three to four
☐1 One or two
☐0 None
☐-9 Don't know
☐9 Not answered

About how many times did you talk to someone - friends, relatives, or others on the telephone in the week before your hip fracture (either you called them or they called you) ? (if subject has no phone, question still applies).

☐3 Once a day or more
☐2 2-6 times
☐1 Once
☐0 Not at all
☐-9 Don't know
☐9 Not answered

How many times during the week before your hip fracture did you spend some time with someone who does not live with you; that is you went to see them or they came to visit you, or you went out to do things together ?

☐3 Once a day or more
☐2 2-6 times
☐1 Once
☐0 Not at all
☐-9 Don't know
☐9 Not answered

Do you have someone you can trust and confide in?

☐1 Yes
☐0 No
☐-9 Don't know
☐9 Not answered

In the weeks before your hip fracture, did you find yourself feeling lonely quite often, sometimes, or almost never?

☐0 Quite often
☐1 Sometimes
☐2 Almost never
☐-9 Don't know
☐9 Not answered

In the weeks before your hip fracture, did you see relatives and friends as often as you want to, or not?

☐1 As often as I want to
☐0 No as often as wants to
☐-9 Don't know
☐9 Not answered

Is there someone who would give you any help at all if you were sick or disabled, for example your husband/wife, a member of your family, or a friend?

☐1 Yes
☐0 No one willing and able to help
☐9 Not answered

if "yes" please answer to a and b questions

a. Is there someone who would take care of you as long as needed, or only for short time, or only someone who would help you now and then (for example, taking you to the doctor, or fixing lunch occasionally,)

☐3 Someone who would take care of subject indefinitely (as long as needed)
☐2 Someone who would take care of subject for a short time (a few weeks to six months)
☐1 Someone who would help the subject now and then (taking him to the doctor or fixing lunch, etc.)
☐-9 Don't know
☐9 Not answered

b. Who is this person?

Name____________________________________

Relationship________________________________

(Code: Spouse=1, Sibling=2, Offspring=3, Grandchild=4, Other Kin=5, Friend=6, Other=7)

What is your highest level of education?

☐1. No Schooling
☐2. Elementary grade_______
☐3. Junior High grade_______
☐4. High School grade_______
☐5. Non-University Degree (Vocational,Technical,Nursing)_________________________

University

☐6.diploma/certificate ☐9.master's degree
☐7.bachelor's degree ☐10.doctorate
☐8.professional degree (vet, DR, dentist, lawyer)

What was your employment status just before you had your hip fracture?

☐1. Employed full time ☐4. Retired ☐7. Disability
☐2. Employed part time ☐5. In school
☐3. Unemployed ☐6. Keeping house

What kind of work did you normally do? That is, what was your job title?_________________________

What kind of work did your husband/wife normally do? That is, what was (his,her)last job title?____

Which statement better reflects your attitude towards religion:

☐1. Religion is very important to you
☐2. Religion is somewhat important to you
☐3. Religion is not important to you.

How would you describe yourself?

☐1. White (Caucasian)
☐2. Chinese
☐3. South Asian (East Indian, Pakistani, Punjabi, Sri Lankan)
☐4. Arab/West Asian (Armenian, Egyptian, Iranian, Lebanese, Moroccan)
☐5. Filipino
☐6. South East Asian (Cambodian, Indonesian, Laotian, Vietnamese)
☐7. Latin-American
☐8. Korean
☐9. Aboriginal (North American Indian, Metis, Inuit)
☐10. Black
☐11 Other____

TELEPHONE INTERVIEW ☐ 3 MONTH ☐ 6 MONTH

PATIENT________________________________ **CASE**____________________

DATE(M/D/Y)______________________ **INTERVIEWER**____________________

We need to ask you some questions about your functional activity now.
If there was no one to help (her or him) with the following, could (you, he, she) do it alone?
(If no, could you do it with assistance)

Items	Unable to perform task	Needs assistance	Fully independent
Feeding *(includes cutting, spreading butter).*	0	5	10
Personal hygiene*(wash hands and face, shave, brush teeth).*	0	0	5
Bathing Self*(must be able to bath or shower without anyone present).*	0	0	5
Dressing**(can put on shoes, socks, pants etc. without help).*	0	5	10
Toileting*(can remove clothes, wipe him/herself, get on and off toilet).*	0	5	10
Bowel control*(no accidents day or night).*	0	5	10
Bladder control*(controls bladder day and night).*	0	5	10
Chair/bed transfers*(can safely transfer from a chair to a bed and back again).*	0	5 - 10	15
Walking***(walks 50 yards without help or supervision but may use aids).*	0	10	15
Stair Climbing*(goes up and down stairs independently).*	0	5	10
Wheelchair****(maneuver corners, position himself near bed, toilet etc.).*	0	0	5

* If patient has special aids that he/she has to wear, he/she must be able to put them on by him/herself or he/she is classified as needing help.

** If the patient is independent with an aid, then patient is independent.

*** Score only if unable to walk.

Notes

- For bowel and bladder control, a patient needs assistance if they have occasional accidents (dribbling, night-time, etc.)
- For chair/bed transfer, a score of 10 is given if patient needs minimal assistance (stand-by) of one and a score of 5 is given for a patient that needs a maximal assistance of 1.

Information obtained from:

☐ 1 Patient ☐ 2 Nurse ☐ 3 Proxy ☐ 4 Other

1. **During the past four weeks, what was your usual level of daily activity?**

☐1 No activity/bed-bound
☐2 Wheelchair
☐3 Walked with personal assistance
☐4 Walked with mechanical assistance
☐5 Walked without assistance
☐6 Walked a half mile or less outside the home each day
☐7 Walked vigorously or jogged more than half a mile each day

2. **During the past four weeks, how frequently did the hip that was fractured cause you any difficulty with the following activities?**

	Never	**Rarely**	**Sometimes**	**Often**	**Always**
Stooping or bending	1	2	3	4	5
Standing up from a chair	1	2	3	4	5
Sitting down in a chair	1	2	3	4	5
Climbing a flight of stairs	1	2	3	4	5
Walking while outdoors	1	2	3	4	5

3. **During the past four weeks, how much pain did you have in the hip that was fractured?**

☐1 None
☐2 Very mild
☐3 Mild
☐4 Moderate
☐5 Severe
☐6 Very severe

RAND-12 HEALTH SURVEY

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to perform your usual activities.

1. In general, would you say your health in the last month was:

Excellent	Very Good	Good	Fair	Poor
1	2	3	4	5

In the past month, did your health limit you in these activities? If so, how much?

	A Lot	A Little	None
2. Moderate Activities, such as moving a table or chair, vacuuming, lifting and carrying groceries	1	2	3
3. Climbing several flights of stairs	1	2	3

4. **During the last month, did you accomplish less of your work or other regular daily activities than you would like as a result of your physical health?** ☐**1 Yes** ☐**0 No**

5. **During the last month, were you limited in the kind of work or other activities you could do as a result of your physical health?** ☐**1 Yes** ☐**0 No**

6. **During the last month, did you accomplish less of your work or other regular daily activities than you would like as a result of any emotional problems (such as feeling depressed or anxious)?** ☐**1 Yes** ☐**0 No**

7. **During the last month, you didn't do work or other activities as carefully as usual as a result of any emotional problems (such as feeling depressed or anxious) ?** ☐**1 Yes** ☐**0 No**

8. **During the last month, how much did pain interfere with your normal work (including work outside the home and housework)?**

Not at all	**A little bit**	**Moderately**	**Quite a bit**	**Extremely**
1	2	3	4	5

How much of the time during the last month:

	All	**Most**	**Good Bit**	**Some**	**A Little**	**None**
9. Have you felt calm and peaceful?	1	2	3	4	5	6
10. Did you have a lot of energy?	1	2	3	4	5	6
11. Have you felt downhearted and blue?	1	2	3	4	5	6

12. **During the last month, how much of the time has your physical or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?**

All of the time	Most of the time	Some of the time	A little of the time	None of the time
1	2	3	4	5

13 How often in the past month have you had difficulty sleeping?

☐1 Not at all
☐2 1-3 nights per week
☐3 Most nights of the week
☐4 Nearly every night for at least 2 weeks

SOCIAL RESOURCES QUESTIONNAIRE

Has marital status changed? ☐1 Yes ☐0 No

☐1 Single (never married)
☐2 Married
☐3 Widowed
☐4 Divorced
☐5 Separated
☐6 Common law
☐9 Not answered

Who lives with you (you may circle more than one number for this question)

☐Home alone
☐Husband or wife
☐Nursing home/Auxiliary
☐Seniors Home
☐Parents
☐Grandparents
☐Children
☐Grandchildren
☐Home unspecified
☐Brothers and sisters
☐Friends
☐Other relatives (does not include in-laws covered in the above categories)
☐Non-related paid helper(includes free-room)
☐Other(specify):______________________________

How many people do you know well enough to visit in their homes?

☐3 Five or more
☐2 Three to four
☐1 One or two
☐0 None
☐-9 Don't know
☐9 Not answered

About how many times did you talk to someone - friends, relatives, or others on the telephone in the last week (either you called them or they called you) ? (if subject has no phone, question still applies).

☐3 Once a day or more
☐2 2-6 times
☐1 Once
☐0 Not at all
☐-9 Don't know
☐9 Not answered

How many times during the last week did you spend some time with someone who does not live with you; that is you went to see them or they came to visit you, or you went out to do things together ?

☐3 Once a day or more
☐2 2-6 times
☐1 Once
☐0 Not at all
☐-9 Don't know
☐9 Not answered

Do you have someone you can trust and confide in?

☐1 Yes
☐-9 Don't know

☐0 No

☐9 Not answered

In the last month, did you find yourself feeling lonely quite often, sometimes, or almost never?

☐0 Quite often

☐1 Sometimes

☐2 Almost never

☐-9 Don't know

☐9 Not answered

In the last month, did you see relatives and friends as often as you want to, or not?

☐1 As often as I want to

☐0 No as often as wants to

☐-9 Don't know

☐9 Not answered

Is there someone who would give you any help at all if you were sick or disabled, for example your husband/wife, a member of your family, or a friend? (If yes, answer questions a and b).

☐1 Yes

☐0 No one willing and able to help

☐-9 Don't know

☐9 Not answered

a. Is there someone who would take care of you as long as needed, or only for short time, or only someone who would help you now and then (for example, taking you to the doctor, or fixing lunch occasionally,)

☐3 Someone who would take care of subject indefinitely (as long as needed)

☐2 Someone who would take care of subject for a short time (a few weeks to six months)

☐1 Someone who would help the subject now and then (taking him to the doctor or fixing lunch, etc.)

☐9 Not answered

b. Who is this person?

Name__________________________________

Relationship__________________________________

(Code: Spouse=1, Sibling=2, Offspring=3, Grandchild=4, Other Kin=5, Friend=6, Other=7)

Have you had any new health problems since you broke your hip? ☐1 Yes ☐0 No

If yes, please specify.____

____

____

Have you been admitted to any hospital since you broke your hip? ☐1 Yes ☐0 No

If yes, please specify?

When(m/d/y)____

Where____

Why____

UNIVERSITY OF ALBERTA HIP FRACTURE STUDY-CHART REVIEW FORM

Patient Name:______________________ Hosp. ID.No.__________ AHIC: __________

Admission date(m/d/y)______________ Admission time__________

Discharge date(m/d/y)______________ Discharge time__________

Ht:______________ Wt:______________

Admitted from:

☐1 Home alone
☐2 Home with spouse
☐3 Home with other(s)
☐4 Home, unspecified
☐5 Nursing home______________
☐6 Rehabilitation facility______________
☐7 Other acute care hospital______________
☐8 Seniors citizens home or lodge______________
☐9 Unknown
☐10 Other (specify)______________
☐11 Group home______________

Discharged to:

☐0 Date of death(m/d/y)______________ Time______________
Cause______________
☐1 Home alone
☐2 Home with spouse
☐3 Home with other(s)
☐4 Home, unspecified
☐5 Nursing home______________
☐6 Rehabilitation facility ☐ Glenrose ☐ Grandview ☐ Good Sam ☐ Other__________
☐7 Other acute care hospital______________
☐8 Seniors citizens home or lodge______________
☐9 Unknown
☐10 Other(specify)______________
☐11 Group home______________

Discharge Diagnosis

______________ ______________ ______________

______________ ______________ ______________

Femoral neck or subcapital: Intertrochanteric Other

☐ 1 Impacted

☐ 2 Non-displaced, non-impacted

☐ 3 Displaced

☐ 4 Unknown

☐ Garden________________

☐ 5 Stable

☐ 6 Unstable

☐ 7 Unknown

☐ 12 Comminuted

☐ 13 Displaced

☐ 14 Impacted

☐ 8 Subtrochanteric

☐ 9 Intertrochanteric/subtrochanteric combination

☐ 10 Unknown

☐ 11 Other (specify)____

Date of surgery__________________ Hemovac ☐ 1 yes ☐ 0 No Date out__________

Surgery start ________________ End ________________ ☐ Spinal ☐ GA ☐ Other_____

Surgeon ______________________________

What surgical treatment was used to correct the fracture?

☐ 1 Percutaneous pinning

Internal fixation with:

☐ 2 Multiple pins or screws

☐ 3 Compression screw slide plate

☐ 4 Combination of screws and slide plate

☐ 5 Intramedullary or condylocephalic rods or other devices, such as Zickel Nails, Sampson Fluted rods, Harris Nails, Reconstruction Nails, Enders Nails.

☐ 6 Hemiarthroplasty with a unipolar prosthesis, such as a Moore prosthesis.

☐ 7 Hemiarthroplasty with a bipolar prosthesis

☐ 8 Total hip arthroplasty (replacement of acetabulum and femoral head)

☐ 9 No surgery-traction or bed rest only

☐ 10 Other____

Was methyl methacrylate cement used?	☐ 1 Yes	☐ 2 No
Bone Graft Allograft	☐ 1 Yes	☐ 2 No
Wires	☐ 1 Yes	☐ 2 No

Other surgical intervention at the time of hip surgery________________________________

____

Did the patient ever previously fracture the same hip?

☐ 1 Yes ☐ 2 No When(m/d/y)______________________

Did the patient ever previously fracture the other hip?

☐ 1 Yes ☐ 2 No When(m/d/y)______________________

Goldman Risk Class__________

MEDICAL HISTORY

Conditions now

☐1. Alcoholism(Male ≥4 drinks/day. Female ≥3 drinks/day)
☐2. Blindness/trouble seeing with glasses
☐3. Arthritis/rheumatism
☐4. CHF
☐5. CAD
☐6. Chronic lung disease
☐7. Pulmonary edema
☐8. Diabetes
☐9. Mental illness
☐10. Severe osteoporosis
☐11. Malnutrition
☐12. Hemiplegia/parapelegia
☐13. Hypothyroid
☐14. CRF
☐27. GERD
☐29. Parkinsons
☐
☐

☐15. Deafness/trouble hearing
☐16.Sciatica/chronic back pain
☐17. Atrial fib
☐18. PVD
☐19. Asthma
☐20. MI within three months
☐21.Ulcer/GI bleeding
☐22. Dementia
☐23. Osteoarthritis
☐24. RA
☐25. ETOH withdrawal/DT'S
☐Do not resuscitate
☐26. Renal failure
☐28. Anemia
☐30. Renal insufficiency
☐

Other____

Conditions ever:

☐1 Hypertension or high blood pressure
☐2 Angina
☐3 Kidney disease
☐Cancer (not including skin cancer)? ________________________________
☐Other ____

☐5 Stroke
☐6 Myocardial infarction

COMPLICATIONS IN HOSPITAL

☐1 Hip joint or wound infection
☐2 Loss of reduction-bone complication
☐3 Refracture about device
☐4 Myocardial infarction
☐5 Embolism
☐6 Pneumonia
☐7 Dislocation of hip
☐8 Loss of reduction-device complication
☐ICU admission
☐10 Stroke
☐11 Thrombosis
☐12 Urinary tract infection
☐Transfusion
  ☐1 Packed cells______________
  ☐2 FFP __________________
  ☐3 Platelets ____________
  ☐4 Penta __________________
  ☐5 Albumin_________________
  ☐6 Cryo _____________ _______
  ☐Other blood________________________________
☐Other____

Delirium or acute confusion in chart ☐1 Yes ☐0 No

Diagnosed by:
☐1 GAT
☐2 NARG
☐3 Medicine
☐4 Nursing
☐5 Ortho
☐6 Neuro

REHAB IN HOSPITAL

Rehab physio start date(M/D/Y)_________________

Weight bearing at discharge

☐1 Feather weight bearing
☐2 Partial weight bearing
☐3 Weight bearing as tolerated
☐4 Other__________________
☐5 Non wt bearing
☐6. Full wt

DIAGNOSTIC TESTS RELATED TO HIP FRACTURE

☐1 CT scan of hip
☐2 Tomograms of hip
☐3 Other____

Trauma
Incident:____
Time of hip fracture:_________________________________Date:__________________________
Foley ☐Yes ☐No Date in:_______________ Date out:____ _____________

MEDICATION IN HOSPITAL

Analegesic Medication

☐Morphine
☐Demerol
☐Codeine

☐Tylenol 3
☐Other narc_________________
☐Non narcotics
List : ______________________________
____
____

Anticoagulation Medication

☐Heparin
☐Enoxiparin

☐Coumadin
☐Other anticoagulant_________________

Laxatives
☐1. Colace 100mg po BID
☐2. Senekot 2 po OD
☐3. Surfak
☐4. Dulcolax supp 1 OD
☐5. MOM 30 mls po OD
☐6. Lactulose
☐7. Metamucil
☐8 .Magnolax
☐9. Glycerine

Type ______________________________ Type ____

Other Hospitalizations

1. Where:____________________
1. When:____________________
1. Why:____________________

2. Where:____________________
2. When:____________________
2. Why:____________________

9.4. Functional Recovery Model

Table 9.4.1 Categorical Variables used in the 3-Month BFI Regression Models

		Control	Caremap
Variable		N (%)	N (%)
Gender	*Female*	329 (78)	292 (80)
	Male	93 (22)	73 (20)
Admitted From:	*Community**	261 (62)	237 (65)
	Lodge	64 (15)	43 (12)
	Institution	97 (23)	85 (23)
Discharged to:	*Community**	21 (5)	39 (11)
	Rehabilitation	330 (72)	240 (66)
	Institution	107 (23)	86 (24)
Cognition	*≥ 22 MMSE*	112 (27)	120 (33)
	<22 MMSE	310 (73)	245 (67)
Charlson Comorbidity:	*None**	127 (30)	90 (25)
	Mild	190 (45)	177 (49)
	Moderate	78 (19)	82 (22)
	Severe	27 (6)	16 (4)
Fracture Site:	*FN**	212 (50)	192 (53)
	IT	208 (49)	165 (45)
	ST	2 (1)	8(2)
Fracture Fixation:	*Arthroplasty**	149 (35)	161 (44)
	Compression Screw Slide Plate	188 (45)	157 (43)
	Cannulated Screws	84 (20)	38 (10)
	IM Nail	0	8 (2)
Postop Stroke	*No*	419 (99)	363 (99)
	Yes	3 (1)	2 (1)
Balance Problems Preop	*No*	380 (90)	351 (96)
	Yes	42 (10)	14 (2)
MSK Problems Preop	*No*	325 (77)	233 (64)
	Yes	97 (23)	132 (36)
Preop Activity Level:	*Independent**	249 (59)	209 (57)
	Mechanical Aids	134 (32)	133 (36)
	Dependent	36 (9)	23 (6)
Married	*No*	310 (74)	245 (67)
	Yes	123 (26)	120 (33)
Social Contact	*No*	109 (27)	84 (23)
	Yes	298 (73)	278 (77)
Presence of Other Fractures	*No*	383 (91)	350 (96)
	Yes	39 (9)	15 (4)
Wound Problems	*No*	409 (97)	354 (97)
	Yes	13 (3)	11 (3)
Myocardial Infarct Postop	*No*	416 (99)	361 (99)
	Yes	6 (1)	4 (1)

LEGEND: BFI = Barthel Functional Index; MMSE = Mini Mental Status Examination; Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.4.2 Continuous Variables Used In 3-Month BFI Regression Models

	Control		Caremap	
Variable	Mean (SD)	N	Mean (SD)	N
Age	81.3 (7.5)	422	81.3 (7.6)	365
Baseline BFI Score	86.3 (20.1)	421	87.0 (18.5)	365
Postop BFI Score	40.7 (20.1)	419	37.0 (18.8)	355
Time To Rehabilitation	3.1 (1.8)	392	2.7 (1.6)	354
LOS	10.3 (6.3)	422	12.9 (8.8)	365
Time to Surgery	1.07 (1.9)	421	1.07 (1.1)	364

LEGEND: BFI = Barthel Functional Index; LOS= Length of Stay

Table 9.4.3 Predictors of 3-Month BFI: Relationship with Group Examined with Analysis of Covariance

	Variable		Group (caremap = 0)		Interaction
Variable	$\beta^{\ddagger}$	95% CI	$\beta^{\ddagger}$	95% CI	P-Value
Age (per year increase)	-1.2	-1.5, -0.95	-3.3	-7.3, 0.76	0.69
Gender (Female = 0)	-1.3	-6.5, 3.9	-3.4	-7.6, 0.89	0.98
Baseline BFI Score (per unit increase)	1.1	0.98, 1.1	-2.6	-5.7, 0.52	0.70
Postop BFI Score (per unit increase)	0.86	0.77, 0.95	-6.6	-10.1, -3.1	0.40
Time to Rehabilitation(per day increase)	-0.34	-1.6, 0.94	-2.4	-6.7, 2.0	0.18
LOS (per day increase	-0.32	-0.60, -0.04	-4.2	-8.5, 0.1	0.51
Admitted From:					0.78
*Community**	1.0	NA	-3.1	-6.4, 0.16	
Lodge	-12.7	-17.6, -7.8			
Institution	-47.2	-51.1, -43.3			
Discharged to:					0.26
*Community**	1.0	NA	-3.5	-6.7, -0.21	
Rehabilitation	-12.1	-18.3, -5.9			
Institution	-57.0	-63.8, -50.2			
Cognition (≥ 22 = 0)	-33.5	-37.1, -29.8	4.0	0.87, 7.7	0.17
Charlson Comorbidity:					0.62
*None**	1.0	NA	-4.3	-8.4, 0.22	
Mild	-16.4	-21.3, -11.5			
Moderate	-22.0	-28.0, -16.1			
Severe	-25.2	-34.7, -15.7			
Fracture Site:					0.13
*FN**	1.0	NA	-3.4	-7.7, 0.81	
IT	-6.1	-10.3, -1.8			
ST	-16.8	-35.8, 0.21			
Fracture Fixation:					0.12
*Arthroplasty**	1.0	NA	-4.2	-8.4, 0.12	
Compression Screw Slide Plate	-5.3	-8.9, -0.65			
Cannulated Screws	7.8	1.4, 14.1			
IM Nail	-0.56	-21.7, 20.6			
Postop Stroke (No = 0)	-26.5	-53.1, 0.06	-3.3	-7.6, 0.90	0.98
Balance Problems Preop (No = 0)	9.0	0.74, 17.3	-2.8	-7.7, 1.4	0.002
MSK Problems Preop (No = 0)	3.6	-1.1, 8.3	-3.9	-8.1, 0.43	0.14
Preop Activity Level:					0.57
*Independent**	1.0	NA	-3.0	-6.9, 0.91	
Mechanical Aids	-12.7	-16.9, -8.5			
Dependent	-44.6	-52.2, -37.1			
Married (Yes = 0)	-6.63	-11.2, -2.0	-3.0	-7.2, 1.3	0.47
Social Contact (Daily/Frequently = 0)	-33.4	-37.7, -29.0	-2.3	-6.1, 1.4	0.005

* = Reference Category.; ‡ = Regression Coefficient
LEGEND: BFI = Barthel Functional Index; CI = Confidence Intervals; LOS = Length of Stay; MSK = Musculoskeletal; FN = Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.4.4 Non-Significant Predictors of 3-Month BFI Scores

	Control			Caremap		
Variable	β‡	SE	P-Value	β‡	SE	P-Value
Presence of Other Fractures (No = 0)	-3.0	5.2	0.57	-8.0	7.7	0.30
Wound Problems (No = 0)	5.6	8.7	0.52	-2.5	9.0	0.78
Myocardial Infarct Postop (No = 0)	-0.83	12.7	0.95	5.4	14.8	0.71
Time to Surgery (per day increase)	0.26	0.82	0.75	-0.92	1.4	0.50

LEGEND: BFI = Barthel Functional Index; SE = Standard Error; ‡ = Regression Coefficient

9.5. Health- Related Quality Of Life Models

Table 9.5.1 Categorical Variables used in the 3-Month PHC and MHC Regression Models

		Control	Caremap
Variable		N (%)	N (%)
Gender	*Female*	300 (77)	290 (80)
	Male	90 (23)	73 (20)
Admitted From:	*Community**	250 (64)	235 (65)
	Lodge	57 (15)	43 (12)
	Institution	83 (21)	85 (23)
Discharged to:	*Community**	21 (5)	39 (11)
	Rehabilitation	288 (74)	238 (66)
	Institution	81 (21)	86 (24)
Cognition	*≥ 22 MMSE*	112 (27)	120 (33)
	<22 MMSE	310 (73)	245 (67)
Charlson Comorbidity:	*None**	118 (30)	90 (25)
	Mild	179 (46)	175 (48)
	Moderate	69 (18)	82 (23)
	Severe	24 (6)	16 (4)
Fracture Site:	*FN**	191 (49)	192 (53)
	IT	197 (49)	163 (45)
	ST	2 (1)	8(2)
Fracture Fixation:	*Arthroplasty**	133 (34)	161 (44)
	Compression Screw Slide Plate	178 (46)	156 (43)
	Cannulated Screws	78 (20)	37 (10)
	IM Nail	0	8 (2)
Postop Stroke	*No*	388 (99)	361 (99)
	Yes	2 (1)	2 (1)
Balance Problems Preop	*No*	351 (90)	349 (96)
	Yes	39 (10)	14 (2)
MSK Problems Preop	*No*	304 (78)	231 (64)
	Yes	86 (22)	132 (36)
Preop Activity Level:	*Independent**	233 (60)	207 (57)
	Mechanical Aids	124 (32)	133 (37)
	Dependent	30 (8)	23 (6)
Social Contact	*No*	90 (24)	84 (23)
	Yes	285 (76)	276 (77)
Presence of Other Fractures	*No*	383 (91)	350 (96)
	Yes	39 (9)	15 (4)
Myocardial Infarct Postop	*No*	384 (99)	359 (99)
	Yes	6 (1)	4 (1)
Married	*No*	107 (27)	118 (33)
	Yes	283 (73)	245 (68)
Use of a Proxy Respondent	*No*	162 (42)	221 (61)
	Yes	228 (59)	142 (39)

LEGEND: PHC = Physical Health Composite; MHC = Mental Health Composite; MMSE = Mini Mental Status Examination; MSK = Musculoskeletal; Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.5.2 Continuous Variables Used In 3-Month PHC and MHC Regression Models

	Control		Caremap	
Variable	Mean (SD)	N	Mean (SD)	N
Age	81.3 (7.6)	390	81.3 (7.6)	363
Baseline BFI Score	87.5 (18.5)	389	87.0 (18.6)	353
Postop BFI Score	41.5 (19.9)	387	36.9 (18.8)	355
Baseline PHC Score	45.6 (10.6)	373	45.0 (10.3)	355
Baseline MHC Score	42.9 (11.4)	358	44.5 (105)	355
LOS	10.3 (6.3)	390	12.9 (8.8)	363

LEGEND: BFI = Barthel Functional Index; PHC = Physical Health Composite; MHC = Mental Health Composite; LOS= Length of Stay

Table 9.5.3 **Predictors of 3-Month PHC Scores: Relationship with Group Examined with Analysis of Covariance**

	Variable		Group (caremap = 0)		Interaction
Variable	$\beta^{\ddagger}$	95% CI	$\beta^{\ddagger}$	95% CI	P-Value
Age (per year increase)	-0.16	-0.25, -0.79	1.1	-0.18, 2.3	0.92
Gender (Female = 0)	-0.12	-1.7, 1.4	1.1	-0.18, 2.4	0.65
Baseline PHC Score (per unit increase)	0.34	0.28, 0.40	0.75	-0.44, 1.9	0.68
Baseline MHC Score (per unit increase)	0.26	0.21, 0.32	1.2	-0.38, 2.5	0.95
Baseline BFI Score (per unit increase)	0.08	0.05, 0.12	0.99	-0.27, 2.2	0.85
Postop BFI Score (per unit increase)	0.08	0.05, 0.11	0.65	-0.62, 1.9	0.79
LOS (per day increase)	-0.17	-0.26, 0.09	0.62	-0.66, 1.9	0.14
Admitted From:					0.23
*Community**			-3.1	-6.4, 0.16	
Lodge	-2.2	-4.1, -0.35			
Institution	-3.2	-51.1, -43.3			
Discharged to:					0.93
*Community**			1.1	-2.3, 0.17	
Rehabilitation	-4.6	-6.9, -2.3			
Institution	-7.2	-4.8, -1.7			
Cognition (≥ 22 = 0)	-3.4	-4.7, -2.2	1.7	0.47, 3.0	0.88
Charlson Comorbidity:					0.38
*None**		NA	0.97	-0.30, 2.2	
Mild	-2.1	-3.6, -0.62			
Moderate	-3.2	-5.1, -1.4			
Severe	-5.1	-8.1, -2.1			
Fracture Site:					0.14
*FN**			1.2	-2.4, 0.21	
IT	-1.0	-2.3, 0.25			
ST	-0.033	-5.9, 5.2			
Fracture Fixation:					0.11
*Arthroplasty**			0.93	-2.2, 0.36	
Compression Screw Slide Plate	-0.71	-2.1, 0.70			
Cannulated Screws	2.1	0.14, 4.0			
IM Nail	-0.47	-6.7, 5.7			
Balance Problems Preop (No = 0)	-3.3	-5.8, -0.74	1.3	0.01, 2.6	0.92
MSK Problems Preop (No = 0)	-1.3	-2.7, 0.15	0.92	-0.37, 2.2	0.89
Presence of Other Fractures (No = 0)	-1.9	-4.4, 0.65	1.2	-0.08, 2.5	0.48
Preop Activity Level:					0.61
*Independent**		NA	0.81	-2.1, 0.42	
Mechanical Aids	-4.6	-5.9, -3.3			
Dependent	-3.6	-6.1, -1.1			
Married (Yes = 0)	0.38	-1.0, 1.8	1.1	-0.16, 2.4	0.05
Social Contact (Daily/Frequently = 0)	-1.7	-3.2, -0.15	0.99	-0.29, 2.3	0.77
Postop Myocardial Infarct (No = 0)	0.59	-4.9, 6.1	1.1	-0.18, 2.4	0.07
Use of a Proxy Respondent (No = 0)	-3.3	-4.6, -2.1	1.7	0.42,23.0	0.75

* = Reference Category.

LEGEND: PHC = Physical Health Composite; MHC = Mental Health Composite; BFI = Barthel Functional Index; CI = Confidence Intervals; LOS = Length of Stay; MSK = Musculoskeletal; ‡ = Regression Coefficient; Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.5.4 **Non-Significant Predictors of 3 Month PHC Scores**

	Control			Caremap		
Variable	β‡	SE	P-Value	β‡	SE	P-Value
Postop Stroke (No = 0)	-7.5	6.6	0.26	-2.7	5.8	0.64

LEGEND: BFI = Barthel Functional Index; SE = Standard Error; ‡ = Regression Coefficient

Table 9.5.5 Predictors of 3-Month MHC Scores: Relationship with Group Examined with Analysis of Covariance

	Variable		Group (caremap = 0)		Interaction
Variable	β‡	95% CI	β‡	95% CI	P-Value
Age (per year increase)	-0.28	-0.38, -0.17	0.002	-1.6, 1.6	0.78
Gender (Female = 0)	-1.6	-3.6, 0.35	0.03	-1.6, 1.71	0.73
Baseline BFI Score (per unit increase)	0.15	0.11, 0.20	-0.08	-1.7, 1.5	0.30
Postop BFI Score (per unit increase)	0.15	0.11, 0.19	-0.80	-2.4, 0.811	0.50
Baseline PHC Score (per unit increase)	0.39	0.31, 0.46	-0.14	-1.7, 1.4	0.87
Baseline MHC Score (per unit increase)	0.53	0.47, 0.60	0.58	-0.89, 2.0	0.48
LOS (per day increase	-0.16	-0.27, -0.05	-0.34	-2.0, 1.3	0.05
Admitted From:					0.83
*Community**			-0.3	-1.6, 1.6	
Lodge	-3.5	-5.9, -1.1			
Institution	-6.8	-8.7, -4.8			
Discharged to:					0.10
*Community**			0.11	-1.5, 1.7	
Rehabilitation	-5.3	-8.2, -2.3			
Institution	-11.1	-14.3, -7.8			
Cognition (≥ 22 = 0)	-6.3	-7.9, -4.7	1.3	-0.32, 2.89	0.94
Charlson Comorbidity:					0.23
*None**			-0.16	-1.8, 1.5	
Mild	-4.8	-6.7, -2.9			
Moderate	-4.5	-6.9, -2.2			
Severe	-7.8	-11.6, -3.9			
Fracture Site:					0.41
*FN**			0.15	-1.5, 1.8	
IT	-2.1	-3.8, -0.50			
ST	-3.6	-10.6, 3.4			
Fracture Fixation:					0.93
*Arthroplasty**			-0.04	-1.7, 1.6	
Compression Screw Slide Plate	-1.5	-3.3, 0.3			
Cannulated Screws	2.1	-0.43, 4.5			
IM Nail	1.9	-6.5, 10.3			
Presence of Other Fractures (No = 0)	-2.5	-5.7, 0.99	0.19	-1.5, 1.8	0.66
Balance Problems Preop (No = 0)	-6.4	-9.5, -3.2	0.50	-1.1, 2.1	0.93
Preop Activity Level:					0.61
*Independent**			-0.13	-1.7, 1.5	
Mechanical Aids	-4.4	-6.1, -2.7			
Dependent	-6.1	-9.2, -2.9			
Married (Yes = 0)	-1.9	-3.7, -0.09	0.18	-1.4, 1.8	0.83
Social Contact (Daily/Frequently = 0)	-2.4	-4.4, -0.48	-0.02	-1.7, 1.6	0.22
Pre Fracture Depression (No = 0)	-1.4	-10.4, 7.6	0.06	-1.6, 1.7	0.77
Use of a Proxy Respondent (No = 0)	-6.4	-8.1, -4.9	1.2	-.035, 0.81	0.90

* = Reference Category.

LEGEND: PHC = Physical Health Composite; MHC = Mental Health Composite; BFI = Barthel Functional Index; CI = Confidence Intervals; LOS = Length of Stay; MSK = Musculoskeletal; ‡ = Regression Coefficient; Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.5.6 Non-Significant Predictors of 3 Month MHC Scores

	Control			Caremap		
Variable	$\beta^{\ddagger}$	SE	P-Value	$\beta^{\ddagger}$	SE	P-Value
MSK Problems Preop (No = 0)	0.29	1.2	0.81	-1.3	1.4	0.36
Postop Myocardial Infarct (No = 0)	-3.8	0.60	0.45	-6.9	0.59	0.22
Postop Stroke (No = 0)	-3.7	7.9	0.64	-937	11.2	0.38

LEGEND: SE = Standard Error; MSK = Musculoskeletal; ‡ = Regression Coefficient

9.6. Institutionalization Model

Table 9.6.1 Categorical Variables Used to Model 6-Month Institutionalization

		Control		Caremap	
Variable		Not Institutionalized (N = 237) N (%)	Institutionalized (N = 58) N (%)	Not Institutionalized (N = 208) N (%)	Institutionalized (N = 46) N (%)
Gender	*Female*	188 (79)	49 (85)	167 (80)	37 (80)
	Male	49 (21)	9 (15)	41 (20)	9 (20)
Admission	*Community*	209 (88)	36 (62)	184 (89)	31 (67)
	Lodge	28 (12)	22 (38)	24 (12)	15 (33)
Cognition	*≥ 22 MMSE*	145 (61)	6 (10)	166 (80)	21 (46)
	< 22 MMSE	92 (39)	52 (90)	42 (20)	25 (54)
Balance Problems Preop	*No*	221 (93)	47 (81)	200 (96)	44 (96)
	Yes	16 (7)	11 (19)	8 (4)	2 (4)
Charlson Comorbidity:	*None**	95 (40)	9 (16)	71 (34)	9 (20)
	Mild	98 (41)	32 (55)	86 (41)	26 (56)
	Moderate	30 (13)	13 (22)	22 (45)	10 (22)
	Severe	14 (6)	4 (7)	6 (3)	1 (2)
Fracture Site:	*FN**	127 (53)	23 (40)	120 (58)	23 (50)
	IT	109 (46)	34 (58)	84 (40)	23 (50)
	ST	1 (1)	1 (2)	4 (2)	0
Fixation:	*Arthroplasty**	84 (36)	18 (31)	98 (47)	18 (39)
	Compression Screw Slide Plate	92 (39)	34 (59)	84 (40)	24 (62)
	Cannulated Screws	60 (25)	6 (10)	26 (13)	4 (9)
Postop Stroke	*No*	236 (99.6)	56 (97)	207 (99.5)	48 (100)
	Yes	1 (0.4)	2 (3)	1 (0.5)	0
Postop Myocardial Infarct	*No*	234 (99)	57 (98)	207 (99.5)	44 (96)
	Yes	3 (1)	1 (2)	1 (0.5)	2 (4)
Postop Confusion	*No*	208 (88)	37 (64)	171 (82)	27 (59)
	Yes	29 (12)	21 (36)	37 918)	19 (41)
Baseline Activity:	*Dependent**	5 (2)	6 (10)	3 (1)	3(7)
	Mechanical Aids Used	57 (24)	24 (41)	66 (32)	24 (52)
	Independent	173 (74)	28 (48)	139 (67)	19 (41)
Social Contact	*No*	23 (10)	21 (38)	23 (11)	8 (18)
	Yes	208 (90)	33 (51)	184 (89)	37 (82)
Marital Status	*No*	160 (68)	47 (81)	126 (61)	36 (78)
	Yes	41(18)	11 (19)	82 (39)	10 (22)
MSK Problems Pre fracture	*No*	193 (81)	46 (79)	140 (67)	29 (63)
	Yes	44 (19)	12 (21)	68 (33)	17 (37)
Social Support	*No*	41 (18)	9 (16)	41 (20)	6 (14)
	Yes	190 (82)	48 (84)	164 (80)	36 (86)
Arrhythmia	*No*	226 (95)	55 (95)	205 (99)	46 (100)
	Yes	11 (5)	3 (5)	3 (1)	0

LEGEND: MMSE = Mini Mental Status Examination; MSK = Musculoskeletal; FN = Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 9.6.2 Continuous Variables Used to Model 6-Month Institutionalization

	Control		Caremap	
Variable	Not Institutionalized (N = 237) Mean (SD)	Institutionalized (N = 58) Mean (SD)	Not Institutionalized (N = 208) Mean (SD)	Institutionalized (N = 46) Mean (SD)
Age in Years	79.2 (7.0)	84.5 (7.1)	79.3 (7.3)	86.5 (5.8)
Baseline BFI Score	95.8 (9.4)	83.4 (16.5)	94.7 (9.2)	84.7 (15.3)
Postop BFI Score	48.6 (17.8)	35.3 (16.9)	44.2 (15.8)	32.5 (13.3)
LOS in Days	9.9 (5.1)	14.7 (9.1)	12.6 (7.5)	18.7 (11.3)
Time to Rehabilitation	3.0 (1.6)	3.6 (2.7)	2.6 (1.3)	2.9 (1.7)

LEGEND: BFI = Barthel Functional Index; SD = Standard Deviation; LOS = Length of Stay

Table 9.6.3 **Predictors of 6-Month Institutionalization: Relationship with Group Examined with Logistic Regression**

	Variable			Group (Caremap = 0)			Interaction P-Value
	OR	95% CI	P-Value	OR	95% CI	P-Value	
Age (per Year increase)	1.1	1.09, 1.18	< 0.001	1.2	0.74, 1.8	0.51	0.33
Gender (Female = 0)	0.62	0.50, 1.5	0.62	1.1	0.70, 1.7	0.73	0.43
Baseline BFI (Per Unit Increase)	0.93	0.92, 0.95	< 0.001	1.1	0.70, 1.8	0.65	0.97
Postop BFI (Per Unit Increase)	0.96	0.94, 0.97	< 0.001	1.2	0.78, 1.9	0.39	0.54
Time to Rehabilitation (per day increase)	1.1	1.02, 1.3	0.03	0.98	0.63, 1.5	0.93	0.92
LOS (per day increase)	1.08	1.05, 1.1	< 0.001	1.4	0.90, 2.3	0.13	0.11
Admission (Community = 0)	4.2	2.5, 6.8	< 0.001	0.93	0.59, 1.4	0.73	0.69
Cognition (≥ 22 MMSE = 0)	7.4	4.4, 12.2	< 0.001	1.5	0.92. 2.4	0.10	0.21
Balance Problems Preop (No=0)	2.5	1.2, 5.1	0.01	1.0	0.68, 1.6	0.85	0.24
Charlson Comorbidity:			0.002	0.86	0.26, 1.33	0.51	0.55
*None**	1.0						
Mild	2.9	1.7, 5.2	< 0.001				
Moderate	2.9	1.5, 5.7	0.002				
Severe	2.3	0.75, 6.7	0.15				
Fracture Site:			0.12	1.1	0.70, 1.7	0.74	0.92
*FN**	1.0						
IT	1.6	1.0, 2.4	0.04				
ST	1.1	0.12, 9.5	0.94				
Fixation:			0.006	1.2	0.75, 1.8	0.5	0.66
*Arthroplasty**	1.0						
Compression Screw Slide Plate	1.6	1.03, 2.62	0.04				
Cannulated Screws	0.57	0.27, 1.20	0.14				
Postop Stroke (No=0)	4.3	0.60, 30.7	0.15	1.1	0.71, 1.7	0.69	1.0
Postop Myocardial Infarct (No=0)	3.3	0.72, 14.8	0.13	1.1	0.72, 1.7	0.65	0.26
Postop Confusion (No=0)	3.7	2.3, 5.9	< 0.001	1.2	0.78, 1.9	0.40	0.58
Baseline Activity:			< 0.001	1.2	0.85, 1.8	0.48	1.0
*Dependent**	1.0						
Mechanical Aids Used	0.36	0.13, 0.98	0.046				
Independent	0.14	0.05, 0.37	< 0.001				
Social Contact (Frequently/Daily = 0)	3.6	2.2, 6.2	< 0.001	1.0	0.64, 1.6	0.99	0.05
Marital Status (Married = 0)	2.1	1.3, 3.5	0.004	1.0	0.67, 1.6	0.89	0.93

LEGEND: BFI = Barthel Functional Index; OR =Odds Ratio; CI = Confidence Intervals; LOS = Length of Stay; MMSE = Mini Mental Status Examination; MSK = Musculoskeletal; FN = Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric

Table 9.6.4 Non-Significant Predictors of 6-Month Institutionalization

	Control			Caremap		
Variable	OR	95% CI	P-Value	OR	95% CI	P-Value
MSK Problems Pre fracture (No = 0)	1.1	0.56, 2.3	0.71	1.2	0.62, 2.3	0.58
Social Support (Yes = 0)	1.2	0.52, 2.5	0.73	1.5	0.59, 3.8	0.39
Arrhythmia (No = 0)	1.1	0.3, 4.2	0.87	0^+	None Institutionalized	

+ Complete Separation

LEGEND: OR =Odds Ratio; CI = Confidence Intervals; MSK= Musculoskeletal

9.6.A Calculation of 95% Confidence Intervals for Odd Ratio for Institutionalization at 6-months Post Fracture in Subjects with Poor Social Contact from the Control Cohort

B1 = Group where SE = 0.32
B2 = Social Contact where SE = 0.51
B3 = Interaction between Group and Social Contact where SE = 0.66

CORR (B1B2) = 0.30
CORR (B1B3) = -0.43
CORR (B2B3) = -0.77

COV (B1B2) = CORR (B1B2) X SE (B1) X SE (B2)
= (0.30) X (0.32) X (0.51)
= 0.049

COV (B1B3) = CORR (B1B3) X SE (B1) X SE (B3)
= (-0.43) X (0.32) X (0.66)
= -0.091

COV (B2B3) = CORR (B2B3) X SE (B2) X SE (B3)
= (-0.77) X (0.51) X (0.66)
= -0.259

VAR (B1B2B3) = VAR(B1) + VAR(B2) + VAR(B3) + 2COV(B1B2) + 2COV(B1B3) + 2COV(B2B3)

$= (0.32)^2 + (0.51)^2 + (0.66)^2 + 2(0.049) + 2(-0.091) + 2(-0.259)$

= 0.196

SE (B1B2B3) $= \sqrt{0.196}$

= 0.44

$e^{-0.43 + 0.32 + 1.26 \pm 1.96(0.44)}$

$e^{-0.43 + 0.32 + 1.26 \pm 0.87}$

9.7. *Mortality Model*

Table 9.7.1 Categorical Variables Used to Model In-Hospital Mortality

		Control		Caremap	
Variable		Alive (N = 626) N (%)	Dead (N = 52) N (%)	Alive (N = 208) N (%)	Dead (N = 48) N (%)
Gender	*Female*	475 (76)	25 (48)	473 (77)	27 (56)
	Male	151 (24)	27 (52)	142 (23)	21 (44)
Admission	*Community*	365 (58)	26 (50)	367 (60)	23 (48)
	Lodge	95 (15)	3 (6)	70 (11)	7 (15)
	Institution	166 (27)	23 (44)	178 (29)	18 (37)
Charlson Comorbidity:	*None**	171 (27)	9 (17)	137 (22)	3 (6)
	Mild	296 (47)	21 (40)	307 (50)	22 (46)
	Moderate	118 (19)	15 (29)	137 (22)	14 (29)
	Severe	41 (7)	7 (13)	34 (6)	9 (19)
Preop Cardiac Disease	*No*	519 (83)	33 (64)	439 (71)	28 (58)
	Yes	107 (17)	19 (36)	176 (29)	29 (42)
Preop Arrhythmias	*No*	539 (86)	41 (86)	493 (80)	32 (67)
	Yes	87 (14)	98 (14)	122 (20)	16 (33)
Preop Aortic Stenosis	*No*	617 (99)	50 (96)	606 (98)	46 (96)
	Yes	9 (1)	2 (4)	9 (2)	2 (4)
Preop CHF	*No*	546 (87)	36 (69)	506 (82)	30 (63)
	Yes	80 (13)	16 (31)	109 (18)	18 (38)
MI 3-mths of Fracture	*No*	622 (99)	**52 (100)**	611 (99)	46 (96)
	Yes	4 (1)	**0**	4 (1)	2 (4)
Preop Pulmonary Edema	*No*	620 (99)	49 (94)	611 (99)	46 (96)
	Yes	6 (1)	3 (6)	4 (1)	2 (4)
Preop Pneumonia	*No*	615 (98)	49 (94)	602 (98)	45 (94)
	Yes	11 (2)	3 (6)	13 (2)	3 (6)
Preop Respiratory Disease	*No*	471 (75)	34 (65)	473 (77)	26 (54)
	Yes	155 (25)	18 (35)	142 (23)	22 (46)
Pre fracture Dementia	*No*	464 (74)	31 (60)	417 (68)	31 (65)
	Yes	162 (26)	21 (40)	198 (32)	17 (35)
Diabetes	*No*	544 (87)	40 (77)	520 (85)	40 (83)
	Yes	82 (13)	12 (23)	95 (15)	6 (17)
Preop Malnutrition	*No*	583 (93)	40 (77)	593 (96)	40 (83)
	Yes	43 (7)	12 (23)	22 (4)	8 (17)
Preop Anemia	*No*	565 (90)	43 (83)	552 (90)	39 (81)
	Yes	61 (10)	9 (17)	63 (10)	9 (19)
Preop Renal Failure	*No*	581 (93)	41 (79)	561 (91)	34 (71)
	Yes	45 (7)	11 (21)	54 (9)	14 (29)
Preop Electrolyte Imbalance	*No*	601 (96)	47 (90)	604 (98)	**48 (100)**
	Yes	25 (4)	5 (10)	11 (2)	**0**
Immuno-suppressed Preop	*No*	622 (99)	51 (98)	610 (99)	44 (92)
	Yes	4 (1)	1 (2)	5 (1)	4 (8)
Postop ICU Admission	*No*	615 (98)	43 (83)	611 (99)	43 (90)
	Yes	11 (2)	9 (17)	4 (1)	5 (10)

Type of Anaesthetic:	*Spinal**	452 (74)	36 (77)	414 (68)	25 (64)
	General	149 (25)	8 (17)	170 (28)	13 (33)
	Combined	14 (2)	3 (6)	22 (4)	1 (3)
Postop Stroke	*No*	621 (99)	48 (79)	610 (99)	45 (94)
	Yes	5 (1)	4 (8)	5 (1)	3 (6)
Postop Myocardial Infarct	*No*	615 (98)	47 (90)	609 (99)	41 (85)
	Yes	11 (2)	5 (10)	6 (1)	7 (15)
Postop CHF	*No*	600 (95)	41 (79)	609 (99)	45 (94)
	Yes	26 (4)	11 (21)	6 (1)	3 (6)
Postop Pulmonary Edema	*No*	592 (95)	41 (79)	597 (97)	43 (90)
	Yes	34 (5)	11 (21)	18 (3)	5 (10)
Postop Pneumonia	*No*	593 (95)	32 (62)	573 (93)	32 (67)
	Yes	33 (5)	20 (38)	42 (7)	18 (33)
Postop Respiratory Problems	*No*	614 (98)	47 (90)	610 (99)	45 (94)
	Yes	12 (2)	5(10)	5 (1)	3 (6)
Postop Sepsis	*No*	625 (99.8)	50 (96)	**615 (100)**	42 (88)
	Yes	1 (0.2)	2 (4)	**0**	6 (12)
Postop Renal Failure	*No*	619 (99)	45 (87)	611 (99)	42 (88)
	Yes	7(1)	7 (13)	4 (1)	5 (13)
Postop GI Bleed	*No*	621 (99)	47 (90)	611 (99)	**48 (100)**
	Yes	5 (1)	5 (10)	4 (1)	**0**
Postop Anemia	*No*	425 (68)	29 (56)	405 (66)	32 (67)
	Yes	201 (32)	23 (44)	212 (34)	18 (33)
Fracture Site:	*FN**	323 (52)	28 (54)	320 (52)	25 (52)
	IT	299 (47)	24 (46)	283 (46)	22 (46)
	ST	4 (1)	0	12 (2)	1 (2)
Fixation:	*Arthroplasty**	232 (38)	17 (36)	259 (43)	17 (44)
	Compression Screw Slide Plate	269 (44)	21 (45)	260 (43)	18 (46)
	Cannulated Screws	114 (19)	9 (19)	64 (11)	0
	IM Nail	0	0	23 (4)	4 (10)
Past MI (>3mths	*No*	561 (90)	44 (85)	543 (88)	40 (83)
	Yes	65 (10)	8 (15)	72 (12)	8 (17)
Preop Neurological Condition	*No*	470 (75)	42 (81)	467 (76)	35 (73)
	Yes	156 (25)	10 (19)	148 (24)	13 (27)
Preop Hypertension	*No*	381 (61)	33 (64)	329 (54)	29 (60)
	Yes	245 (39)	19 (36)	286 (46)	19 (39)
Postop Arrhythmias	*No*	592 (95)	50 (96)	607 (99)	**48 (100)**
	Yes	34 (5)	2 (4)	8 (1)	**0**
Number of Complications	*< 3*	528 (84)	32 (62)	548 (89)	28 (58)
	3 or more	98 (16)	20 (38)	67 (11)	20 (42)

LEGEND: CHF= Congestive Heart Failure; ICU = Intensive Care Unit; GI = Gastrointestinal; MI = Myocardial Infarction; FN = Femoral Neck; IT = Intertrochanteric; ST = Sub-trochanteric; IM = Intramedullary

Table 9.7.2 Continuous Variables Used to Model In-Hospital Mortality

	Control		Caremap	
Variable	Alive (N = 626) Mean (SD)	Dead (N = 52) Mean (SD)	Alive (N = 615) Mean (SD)	Dead (N = 48) Mean (SD)
Age in Years	81.7 (7.7)	85.2 (8.5)	81.7 (7.7)	86.2 (8.5)
Time to Rehabilitation	3.3 (2.9)	3.1 (1.9)	2.6 (1.7)	2.7 (1.4)

LEGEND: SD = Standard Deviation

Table 9.7.3 **Predictors of In-Hospital Mortality: Relationship with Group Examined with Logistic Regression**

	Variable			Group (Caremap = 0)			Interaction P-Value
	OR	95% CI	P-Value	OR	95% CI	P-Value	
Age (per Year increase)	1.07	1.04, 1.1	< 0.001	1.1	0.73, 1.7	0.66	0.65
Gender (Female = 0)	2.8	1.8, 4.2	< 0.001	1.05	0.69, 1.6	0.82	0.78
Charlson Comorbidity:			< 0.001	1.1	0.73, 1.7	0.66	0.48
*None**	1.0						
Mild	1.8	0.95, 6.5	0.07				
Moderate	2.9	1.5, 5.9	0.002				
Severe	5.9	2.5, 12.1	< 0.001				
Admitted From:			0.02	1.08	0.72, 1.6	0.72	0.17
*Community**	1.0						
Lodge	0.90	0.45, 1.8	0.77				
Institution	1.8	1.2, 2.8	0.01				
Preop Cardiac Disease (No=0)	2.2	1.4, 3.4	< 0.001	1.2	0.78, 1.8	0.44	0.30
Preop Arrhythmias (No=0)	1.8	1.2, 3.0	0.10	1.1	0.74, 1.7	0.61	0.69
Preop Aortic Stenosis (No=0)	2.8	0.94, 8.5	0.06	1.1	0.71, 1.6	0.76	0.94
Preop CHF (No=0)	2.9	1.9, 4.5	< 0.001	1.1	0.76, 1.7	0.53	0.85
MI 3-mths of Fracture (No=0)	3.2	0.66, 15.1	0.15	1.1	0.71, 1.6	0.74	0^+
Preop Pulmonary Edema (No=0)	6.5	2.2, 19.3	0.001	1.0	0.70, 1.6	0.82	0.97
Preop Pneumonia (No = 0)	3.2	1.3, 8.1	0.01	1.1	0.71, 1.6	0.74	0.91
Preop Respiratory Disease (No=0)	2.1	1.4, 3.2	< 0.001	1.1	0.70, 1.6	0.79	0.19
Pre fracture Dementia (No=0)	1.5	0.99, 2.3	0.06	1.1	0.72, 1.6	0.68	0.23
Diabetes (No=0)	1.5	0.90, 2.5	0.12	1.1	0.71, 1.6	0.74	0.26
Preop Malnutrition (No=0)	3.7	2.1, 6.7	< 0.001	0.98	0.65, 1.5	0.92	0.68
Preop Anemia (No=0)	2.0	1.2, 3.4	0.01	1.1	0.71, 1.6	0.75	0.93
Preop Renal Failure (No=0)	3.9	2.4, 6.4	< 0.001	1.1	0.74, 1.7	0.62	0.68
Preop Electrolyte Imbalance (No=0)	1.7	0.67, 4.6	0.25	1.0	0.69, 1.6	0.84	0^+
Immuno-suppressed Preop (No=0)	7.3	2.4, 22.3	< 0.001	1.1	0.73, 1.7	0.67	0.33
Type of Anaesthetic:			0.65	1.2	0.77, 1.9	0.44	0.25
*Spinal**	1.0						
General	1.6	0.55, 4.7	0.38				
Combined	0.95	0.57, 1.9	0.83				
Postop ICU Admission (No=0)	13.4	6.2, 28.8	< 0.001	0.96	0.63, 1.5	0.87	0.62
Postop Stroke (No=0)	9.3	3.4, 24.9	< 0.001	1.1	0.70, 1.6	0.78	0.81
Postop Myocardial Infarct (No=0)	9.8	4.5, 21.2	< 0.001	1.0	0.69, 1.6	0.83	0.18

Postop CHF (No=0)	6.3	3.2, 12.5	< 0.001	0.92	0.60, 1.4	0.69	0.91
Postop Pulmonary Edema (No=0)	4.4	2.4, 1.5	< 0.001	0.98	0.65, 1.5	0.94	0.77
Postop Pneumonia (No=0)	8.8	5.5, 14.1	< 0.001	1.1	0.73, 1.7	0.62	0.30
Postop Respiratory Problems (No=0)	6.2	2.6, 14.9	< 0.001	1.0	0.67, 1.5	0.94	0.67
Postop Sepsis (No=0)	110.5	13.6, 895.6	< 0.001	1.1	0.74, 1.7	0.56	0^+
Postop Renal Failure (No=0)	16.7	7.3, 36.3	< 0.001	1.0	0.67, 1.6	0.91	0.60
Postop GI Bleed (No=0)	7.2	2.3, 21.9	0.001	1.0	0.68, 1.6	0.90	0^+
Postop Anemia (No=0)	1.3	0.84, 2.0	0.24	1.1	0.71, 1.6	0.75	0.19

$^+$ = cell separation

LEGEND: OR =Odds Ratio; CI = Confidence Intervals; CHF= Congestive Heart Failure; ICU = Intensive Care Unit; GI = Gastrointestinal; MI = Myocardial Infarction

Table 9.7.4 Non-Significant Predictors of In-Hospital Mortality

	Control			Caremap		
Variable	OR	95% CI	P-Value	OR	95% CI	P-Value
Fracture Site:			0.96			1.0
*FN**	1.0			1.0		
IT	0.93	0.53, 1.6	0.79	1.0	0.55, 1.8	0.99
ST	0^+			[illegible]	0.13, 8.5	0.95
Fixation:			1			0.42
*Arthroplasty**	1.0			1.0		
Compression Screw Slide Plate	1.1	0.55, 2.1		1.1	0.53, 2.1	0.88
Cannulated Screws	1.1	0.47, 2[illegible]		0^+		
IM Nail	0^+			2.7	0.82, 8.5	< 0.001
Time to Rehabilitation (per day increase)	0.98	0.[illegible]	[illegible]	1.03	0.85, 1.2	0.79
Past History of MI (>3mths) (No = 0)	1.6	0.[illegible], 3.5	0.27	1.5	.068, 3.4	0.31
Preop Neurological Condition (No = 0)	0.72	0.35, 1.5	.072	1.2	0.60, 2.3	0.64
Preop Hypertension (No = 0)	0.90	0.50, 1.6	0.71	0.75	.041, 1.4	0.36
Postop Arrhythmias (No = 0)	0.70	0.16, 3.0	0.63	0^+		

+ = Zero Cell

LEGEND Femoral Neck; IT = Intertrochanteric; ST = Sub-trochant[illegible]c; IM = Intramedullary